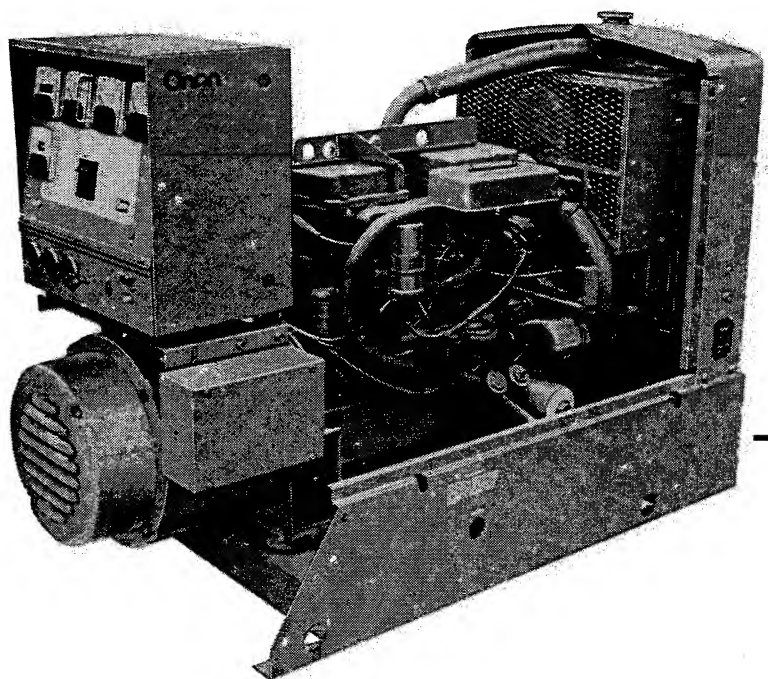


# Onan

## Operator's Manual

### RJC GenSet



# Safety Precautions

---

**Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

**▲ DANGER** *This symbol warns of immediate hazards which will result in severe personal injury or death.*

**▲ WARNING** *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

**▲ CAUTION** *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

**FUEL AND FUMES ARE FLAMMABLE.** Fire and explosion can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Do not smoke while servicing lead acid batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

## EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

## MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.

- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

## ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

## GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

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# Section 1. Introduction

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## ABOUT THIS MANUAL

This manual provides general information for operating and maintaining this Onan generator set. Study this manual carefully, and observe all warnings and cautions. Using the generator set properly and following a regular maintenance schedule will contribute to longer unit life, better performance, and safer operation.

More detailed service manuals are available. To obtain them, contact an Onan distributor.

## HOW TO OBTAIN SERVICE

When the generator set requires service, contact an Onan distributor for assistance. Always supply the complete model number and serial number as shown on the Onan nameplate. The Onan nameplate is located on the side of the generator control box.

### **⚠ WARNING**

***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.***



# Section 2. Specifications

---

## Generator

Type .....	Onan YD Revolving Field, 4-Pole Brushless
Phase .....	1, 3
Ratings	
60 Hz Continuous Standby .....	12.5, 15 kW
50 Hz Continuous Standby .....	12.5
Initial Random Frequency Variation .....	±0.5 percent
Initial Random Voltage Variation .....	±0.5 percent

## Engine

Engine .....	Onan J Series, 4 Cylinder
Engine Speed	
60 Hz .....	1800 r/min
50 Hz .....	1500 r/min
Gasoline Fueled Sets	
Recommended Fuel .....	Unleaded Gasoline (85 Octane)
Gaseous Fueled Sets	
Recommended Fuel .....	(HD5) LPG Vapor or Natural Gas
Ampere/Hour Rating .....	105
Voltage .....	12
Quantity Required .....	1
Cooling System Capacity (Engine and Radiator) .....	12 qts (11.4 l)
Engine Oil Capacity (with filter) .....	6.5 qts (6.15 l)

## Tune-Up Specifications

Spark Plug Gap .....	0.035 in. (0.9 mm)
Ignition Timing .....	25° at 1500 r/min. 35° at 1800 r/min





# Section 3. Installation

## GENERAL

Installations must conform to local building codes, fire ordinances, and other local, state, and federal regulations. See Figure 3-1.

**▲WARNING** *Incorrect installation, service, or parts replacement can result in severe personal injury, death, and/or equipment damage. Service personnel must be qualified to install electrical and mechanical components. Installation requirements include:*

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of circulated air
- Discharge of exhaust gases
- Electrical connections
- Fuel connections
- Accessibility for operation and servicing
- Vibration isolation
- Noise levels

## LOCATION

Provide a location that is protected from the weather and dry, clean, dust-free and well-ventilated.

The air discharge side of the set requires 3 inches (76 mm) clearance, to permit the set to rock on its mounts; at least 24 inches (610 mm) clearance is required around the other sides for service access.

### ▲WARNING

*Exhaust gas is poisonous and presents the hazard of severe personal injury or death. Do not mount the generator set in such a position that the exhaust system terminates directly under any vent, window, door, or any opening that can be opened and is not permanently sealed from any space occupied by people. Keep all openings closed when the generator set is running.*

## MOUNTING

A permanent installation requires a sturdy, level mounting base of concrete, heavy wood or structural steel, preferably raised for easy operation and oil changing. The set may be bolted in position if desired.

### ▲WARNING

*Exhaust gas is poisonous and presents the hazard of severe personal injury or death. Use only Onan-specified exhaust components and support the exhaust system per the exhaust kit instructions.*

## VENTILATION AND COOLING SYSTEM

Generator sets create a considerable amount of heat, which must be removed by ventilation. Outdoor installations rely on natural air circulation, but mobile and indoor installations need vents of the proper size and position for air flow.

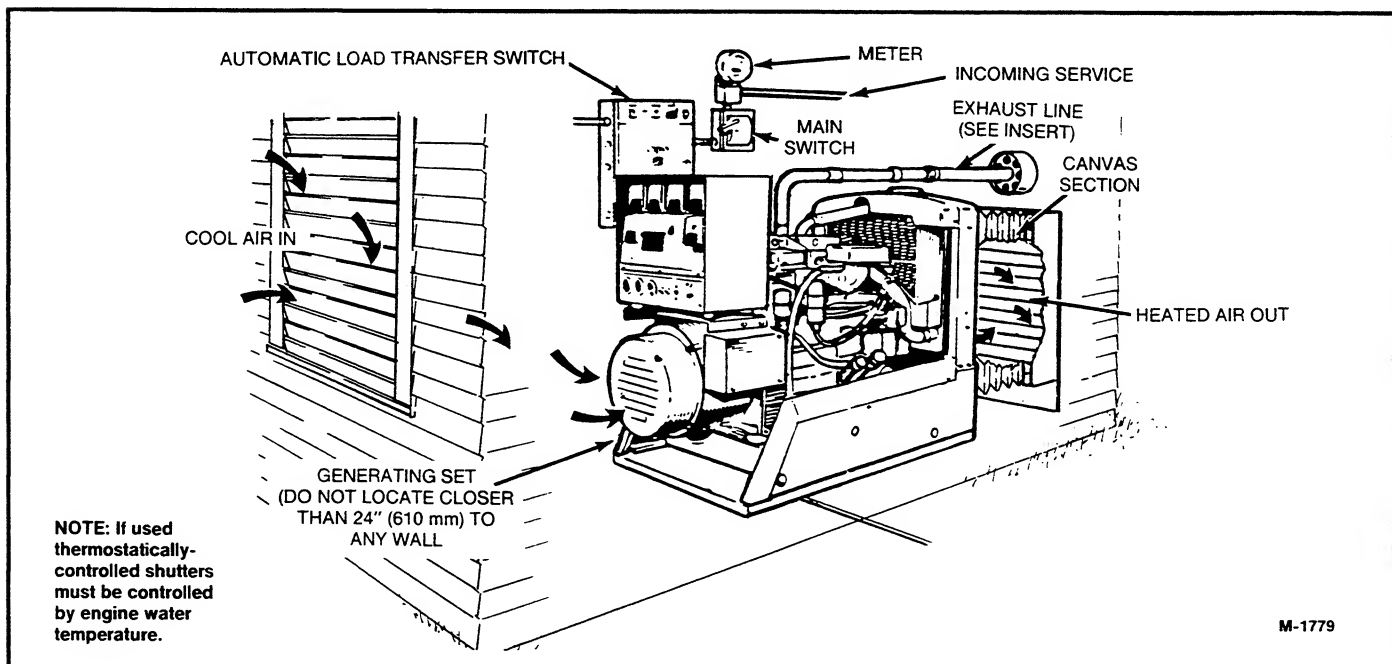


FIGURE 3-1. TYPICAL INSTALLATION

If the generator set has a radiator, its engine-pusher fan removes heat from the engine, generator, and a few feet of uninsulated exhaust pipe. Restrictive ducting or additional heat sources in the area require more fans to increase air flow.

If the generator set does not have a radiator, ventilation fans are required in the area. Fan size must be adequate to remove all heat produced in the room by the generator set, uninsulated exhaust pipes and other equipment. A temperature differential of 20° to 30° F (11° to 17° C) between the genset area and the outside is usually satisfactory.

### Radiator Cooling

Cooling air travels from the rear to the front of the set. The room or compartment air inlet should be in the most convenient location, preferably to the rear of the set. The inlet opening should be at least as large as the radiator area. Enlarge the opening area if it is restricted with louvers or filters. See Figure 3-1.

Engine heat is removed by a pusher fan, which blows air through the front of the radiator. The air outlet should be directly in front of the radiator and as close as is practical. Outlet size should be as large as the radiator area. A canvas or sheet metal duct must extend between the radiator and the air outlet, to prevent recirculation of heated air.

Cooling air is discharged from the engine-to-generator adapter on the left side of the engine.

### Heat Exchanger Cooling (optional)

This closed cooling system is commonly referred to as fresh water cooling. See Figure 3-2. Water circulated through the engine is called captive water. Water circulated only through the heat exchanger is called raw water, cold water, city water, etc. The heat exchanger system (with captive anti-freeze) is recommended where freezing hazards exist or where salt water cooling is preferable.

Fill closed cooling systems with clean, alkali-free water to the proper level in the expansion tank. Add an approved rust inhibitor to the coolant. If the coolant is anti-freeze, test it periodically.

The raw water side of the heat exchanger is protected from corrosion by two zinc pencils (see Figure 3-2). The pencils should be inspected every two months and replaced when worn to less than 1/2 inch (13 mm) length.

#### CAUTION

**Loss of coolant during operation can result in overheating and serious engine damage. Use an expansion tank to prevent this and maintain a proper water level.**

Use a centrifugal metal impeller water pump (Oberdorfer 1-GP or equivalent) in the hot water side. Drive it with a belt from the engine power takeoff.

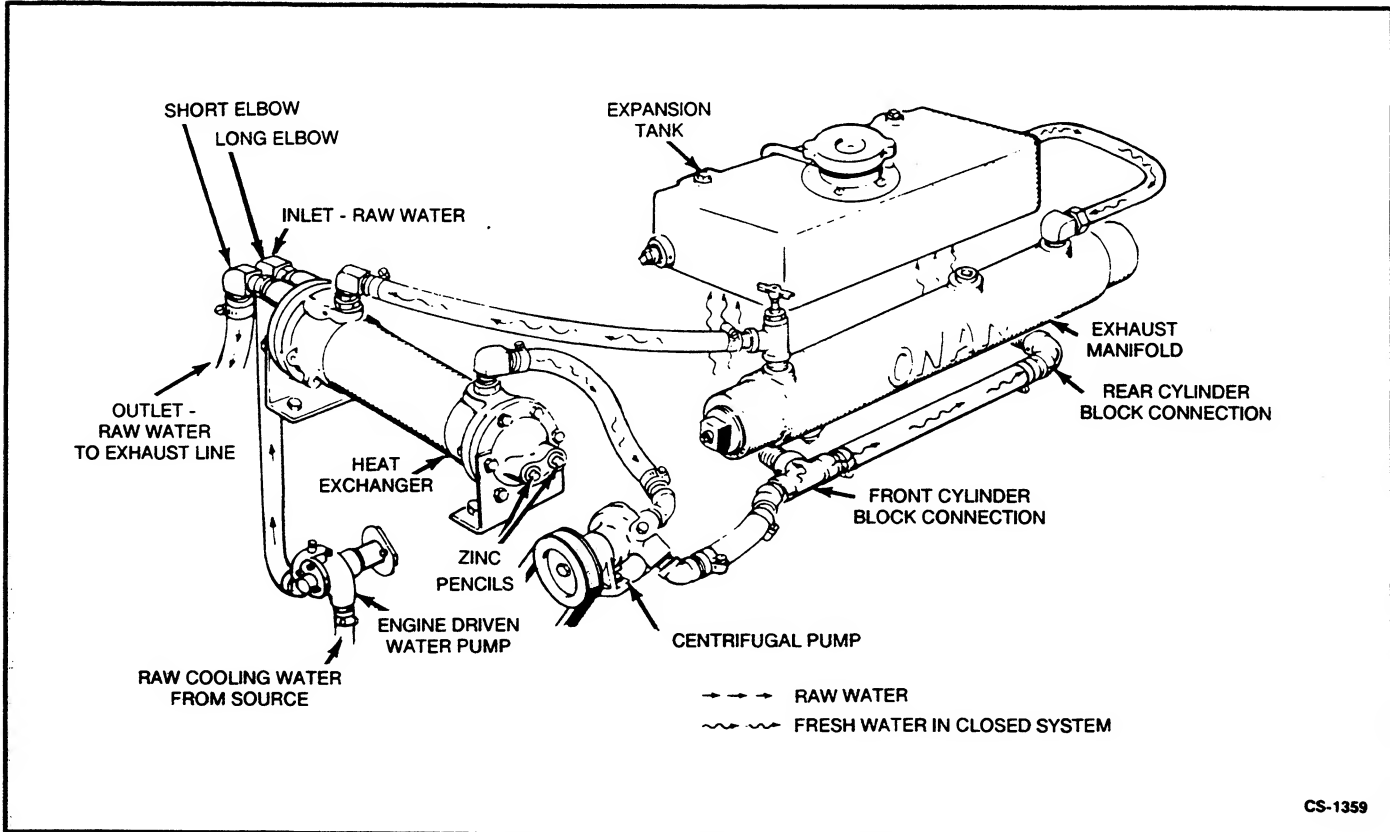


FIGURE 3-2. HEAT EXCHANGER PLUMBING

### City Water Cooling (Optional)

On city water-cooled sets, a constant water flow cools the engine, and a radiator is not used. Fresh air flow must be available to cool the generator and support combustion. In small compartments, a duct larger than the generator outlet opening is necessary to remove heated air from the generator to the outside. Limit bends and use radius-type elbows in the duct. A large, well-ventilated compartment does not require a hot air duct. Water-cooled exhaust manifolds are recommended in this case.

Engine connections are 3/8 inch pipe. A solenoid shut-off valve and a manual supply valve are furnished but not installed. The solenoid valve shuts off the water supply when the set is not in use.

The manual supply valve controls water rate for minimum water use. Final adjustment should be made with the genset under maximum load, with the engine warmed up and water temperature stabilized.

## EXHAUST SYSTEM

Pipe exhaust gases outside the enclosure. The exhaust pipe size is 1-1/2 inches. Locate the exhaust outlet far from the air inlet, so gases do not reenter the enclosure. Use flexible tubing to connect between the engine exhaust and any rigid pipe extension, so vibration is not transmitted.

**▲WARNING** *Inhalation of exhaust gases can result in severe personal injury or death. Use extreme care during installation to provide a tight exhaust system. Exhaust installations are subject to extreme heat, infrequent operation, light operating loads, and other adverse conditions. Frequent and regular inspections are necessary so that the exhaust system remains fume-tight and safe for operation.*

**▲WARNING** *Inhalation of exhaust gases can result in severe personal injury or death. Do not use exhaust heat to warm a room, compartment, or storage area.*

**▲WARNING** *Exhaust gases can overheat flammable materials and cause fire. Shielding may be necessary. Consult an Onan representative for more information.*

Use an approved thimble (Figure 3-3) to pass exhaust pipes through walls or partitions. Refer to NFPA 37, Section 6-3, "Stationary Combustion Engines and Gas Turbines" for thimble design. Follow the local code requirements at the installation site.

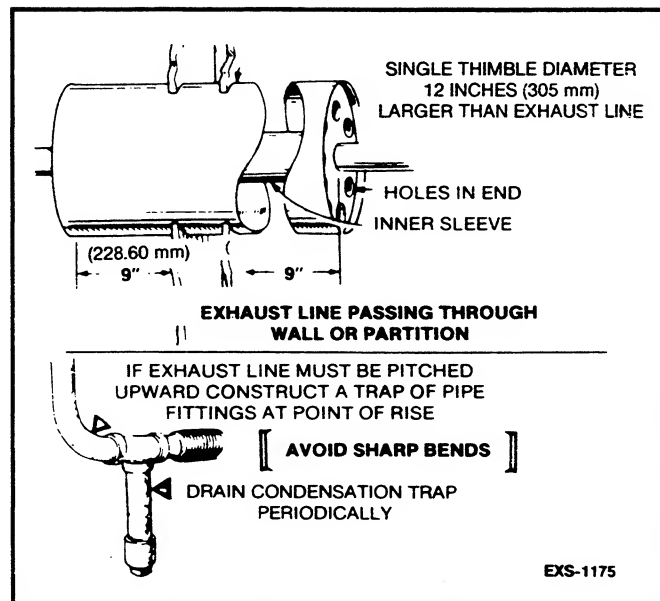


FIGURE 3-3. EXHAUST THIMBLE AND DRAIN

As the exhaust pipe length and number of bends increases, larger pipe is necessary to minimize exhaust restriction and back pressure. Table 3-1 lists the maximum equivalent exhaust pipe length for 1-1/2 inch through 3-inch pipes, and the equivalent lengths of various pipe fittings. The total exhaust system equivalent length (including all fittings and muffler) must not exceed the length shown in Table 3-1 for the size of pipe used. Exceeding this length will cause excessive back pressure in the system. Maximum allowable back pressure measured at the exhaust manifold is 27.2 inches (691 mm) H<sub>2</sub>O.

## FUEL SYSTEM

### Fuel Connection

Connect the fuel line to the fuel pump inlet. The pump is threaded 7/16-24 NPTF (American Standard Internal Tapered Pipe Thread).

**⚠ WARNING** *Fuel leaks create fire and explosion hazards which can result in severe personal injury or death. Always use approved flexible tubing between the engine and the fuel supply to avoid line failure and leaks due to vibration. The fuel system must meet applicable codes.*

For gaseous sets (see Figure 3-4), check the local fuel supplier for gas regulations and line pressure. Provide a manual gas valve. A filter in the line may be necessary. Electric solenoid shut-off valves in the supply line are normally required for indoor automatic or remote starting installations. Connect the solenoid wires to the battery ignition circuit to open the valve during operation. Install a demand-type gas regulator according to instructions, and position it near the set to aid starting.

**⚠ WARNING** *Fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette or other ignition source near the fuel system.*

### Oil Drain

The oil base has a 1/2 inch pipe size tapped hole for draining the oil. This may be fitted with a drain valve as required to suit installation.

**TABLE 3-1. EXHAUST LENGTH**

**MAXIMUM EQUIVALENT EXHAUST PIPE LENGTH - ONE CRITICAL MUFFLER INCLUDED**

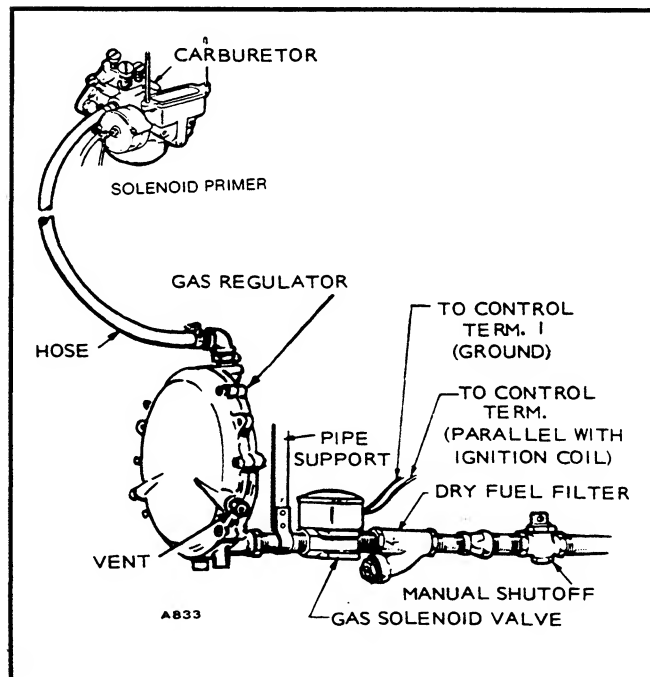
PIPE SIZE (INCHES)	1.5	1.75	2.0	2.5	3
MAXIMUM PIPE LENGTH IN FEET	11 (3.4)	24 (7.3)	46 (14)	124 (38)	391 (119)

(Metres in Parentheses)

Max Allowable Back Pressure is 27.2 inches (691 mm) H<sub>2</sub>O

**EQUIVALENT LENGTHS OF PIPE FITTINGS**

TYPE OF FITTING Inches	1.5	2	2.5	3
STANDARD ELBOW Feet (Metres)	4.4 (1.34)	5.3 (1.62)	6.4 (1.95)	8.1 (2.47)
LONG RAD ELBOW Feet (Metres)	2.8 (0.85)	3.5 (1.07)	4.2 (1.28)	5.2 (1.58)
MED RAD ELBOW Feet (Metres)	3.6 (1.10)	4.6 (1.40)	5.4 (1.64)	6.8 (2.07)
STANDARD TEE Feet (Metres)	9.3 (2.83)	13 (3.96)	14 (4.27)	17 (5.18)



**FIGURE 3-4. GAS REGULATOR**

## AC WIRING

### Generator Voltage Connections

The generator output voltages and maximum current rating are specified on the generator nameplate. Line-to-neutral voltage is always the lower voltage shown on the nameplate and line-to-line voltage is the higher rating.

**⚠ WARNING** *Improper wiring can result in fire and severe personal injury or death. Do not connect electrical wiring to the fuel line.*

**Reconnectable Generators, Code J (formerly 3C or 53C):** Single phase 60 and 50 hertz generators have output leads T1, T2, T3 and T4 available for the single phase voltage and load connections shown in Figure 3-5. Output leads are shown in Figure 3-6.

**Generators, Code L (formerly 18 or 518):** The three-phase, broad range, 60 and 50 hertz 12-lead generators have output leads T1 through T12 available for making several single and three-phase voltage load connections shown in Figure 3-6.

**Non-reconnectable Generators, Code H (formerly 9X):** These special-order, three-phase, 60 hertz, 4-wire generators are rewired at the factory to provide 347/600 VAC. Output leads T1, T2, T3, and T0 are available for connection to the load wires. See connection diagram, Figure 3-6.

**⚠ WARNING** *Accidental starting of the generator set during installation creates a hazard of serious personal injury or death. Do not connect the starting batteries until instructed to later in this section.*

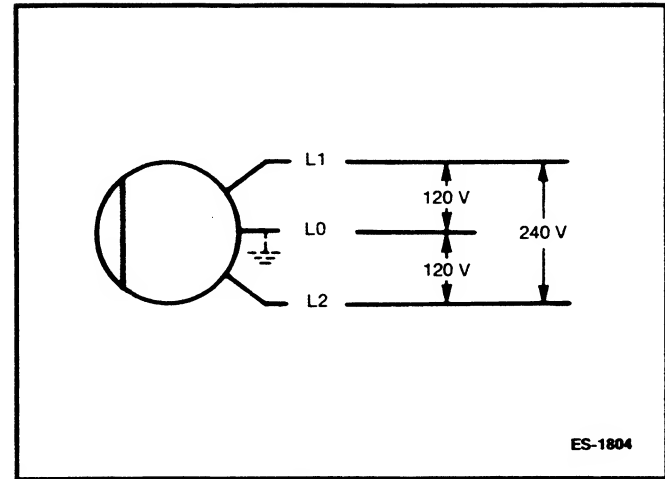


FIGURE 3-5. 120/240 VOLT, SINGLE PHASE

NAMEPLATE VOLTAGE CODE					VOLTAGE		PHASE		FREQUENCY		CONNECT W/O JUMPER WIRE FROM V4 TO:		GENERATOR CONNECTION		GENERATOR CONNECTION SCHEMATIC DIAGRAM		LOAD-TO-GENERATOR CONNECTIONS	
CONNECT X1 TO TERMINAL 5 OF PRINTED CIRCUIT BOARD FOR 50 Hz. TO TERMINAL 6 FOR 60 Hz.																		
R	120/240	I	60	V1		240 V	120 V	120/240 V	240 V	120 V	120/240 V							
P	120/240	I	50	V3														
	115/230	I	50	V2														
	110/220	I	50	V1														
L	120/208 127/220 139/240	3	60	V1 V2 V4	PARALLEL WYE													
Z	110/190	3	50	V1														
	115/200	3	50	V2														
	120/208 127/220	3	50	V3 V4														
L	240/416 254/440 277/480	3	60	V1 V2 V4	SERIES WYE													
Z	220/380	3	50	V1														
	230/400	3	50	V2														
	240/416 254/440	3	50	V3 V4														
L	120/240	3	60	V1	SERIES DELTA													
Z	110/220	3	50	V1														
	115/230	3	50	V2														
	120/240	3	50	V3														
L	120/240	I	60	V1	DOUBLE DELTA													
Z	110/220	I	50	V1														
	115/230	I	50	V2														
	120/240	I	50	V3														
L	120	I	60	V1	PARALLEL DELTA													
Z	110	I	50	V1														
	115	I	50	V2														
	120	I	50	V3														
H	347/600	3	60	V4	WYE													

B206

FIGURE 3-6. GENERATOR WIRING AND CONNECTION DIAGRAMS

### Load Connections

The control box (junction box) has knockouts to accommodate load wires. Use flexible conduit and stranded load wires near the set to isolate vibration. Use the correct size insulated wires for the load rating applied.

Connect each load wire to the proper generator output lead inside the control box. Insulate the bare ends of the ungrounded wires. Use the bolt provided on the control box to connect the generator ground lead or earth wire. Install a fused main switch (or circuit breaker) between the generator and the load. If a test run indicates the wrong rotation of 3-phase motors in the load circuit, switch the connections at any two of the generator terminals.

### Standby

If the installation is for standby service, install a manual or automatic double-throw transfer switch to prevent feeding generator output into the normal power source lines, and to prevent commercial and generator power from being connected to the load at the same time. Instructions for connecting an automatic load transfer switch are included with the transfer switch. See Figure 3-7.

### Load Balancing

Balance genset loads so the current flow from each line terminal (L1, L2 and L3) is approximately the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading is acceptable if line currents are roughly the same (within 10 percent of median value), and no line current exceeds the nameplate rating of the generator. Check the current on each line at the control panel ammeter.

### Grounding

Grounding involves making a connection between the earth and the metal parts of the genset, or one of its circuits. A grounding system is affected by factors such as multiple transformers, ground fault protection requirements, and generator location. Follow the recommendations of the consulting engineer when installing the grounding system.



**WARNING** *Contact with electrical equipment can result in severe personal injury or death. It is extremely important that bonding and equipment grounding be properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.*

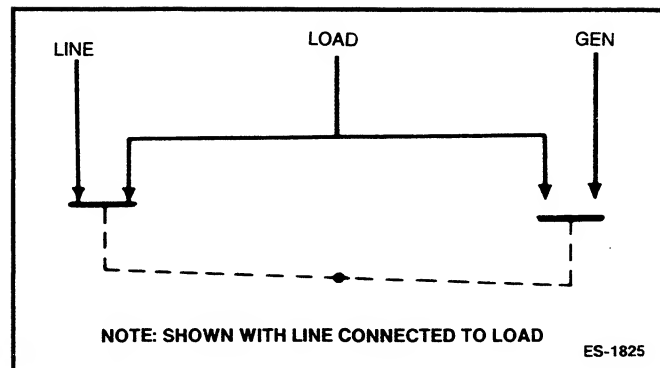


FIGURE 3-7. LOAD TRANSFER SWITCH

**Coolant Heater (optional)**

A electric coolant heater keeps engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces startup time and lessens engine wear caused by cold starts. The coolant heater is thermostatically controlled.

**CAUTION**

*The heater must not be operated while the cooling system is empty or when the engine is running or damage to the heater will occur.*

Connect the heater to a power source that is active during the time the engine is not running. Be sure the voltage rating and phase are correct for the heater element rating.

**DC WIRING**

**Remote Control (Optional)**

For remote control starting and stopping, use 2 wires to connect the SPST remote switch to the terminal block, marked "B+" and "Remote" in the control box, using wire sizes listed in Figure 3-8.

Always run remote control wiring in a separate conduit from the AC power cables, to avoid inducing currents that could cause problems in the control circuit. If PVC conduit is used, the remote wiring must be shielded.

**CAUTION**

*The remote control wiring can easily be damaged. Do not route the remote control wiring over hot, sharp, or abrasive surfaces.*

**Ground Connection**

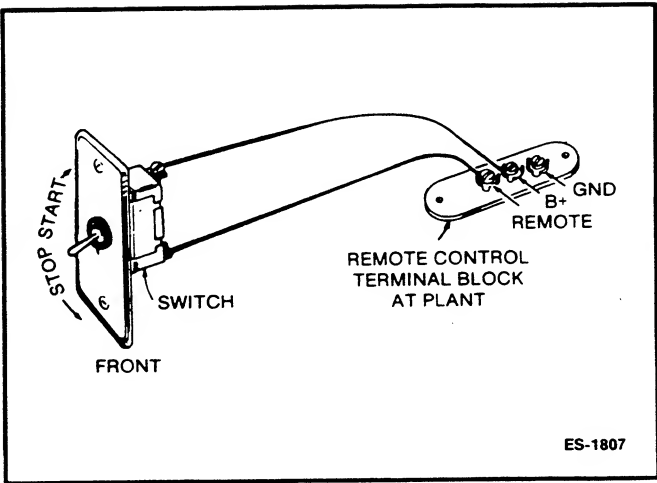
A ground terminal labeled GND, is provided on the remote control terminal block. It may be used for any customer-supplied (optional) accessories.

**Battery Connection**

The battery is connected for negative (-) ground (see Figure 3-9). Be sure all battery connections are secure. See Section 2 of this manual for 12-volt battery requirements. Connect battery positive (+) to the starter, engaging the solenoid terminal post (Figure 3-9). Connect battery negative (-) to a grounding point on the engine.

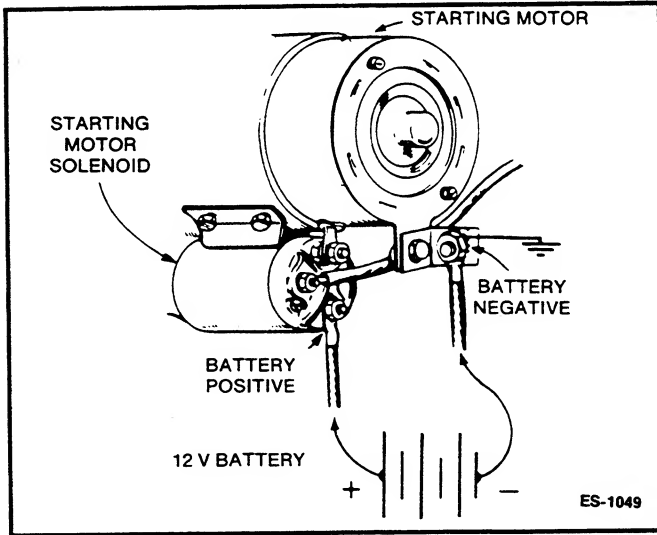
**WARNING**

*Sparks can ignite battery gases and result in an explosion and severe personal injury. Be sure to connect battery positive (+) before connecting battery negative (-), thereby reducing the possibility of arcing.*



WIRE SIZE	DISTANCE
#18	to 900 ft ( 279 m)
#16	to 1500 ft ( 465 m)
#14	to 2400 ft ( 744 m)
#12	to 3700 ft (1147 m)

FIGURE 3-8. REMOTE CONTROL



CABLE SIZE						
mm	6.5	7.3	8.3	9.3	10.5	11.6
INCH	.258	.289	.325	.365	.410	.460
WIRE SIZE	2	1	0	00	000	0000
LOOP	4 ft 1.24 m	5 ft 1.55 m	7 ft 2.17 m	9 ft 2.79 m	11 ft 3.41 m	14 ft 4.34 m

FIGURE 3-9. BATTERY CONNECTIONS AND CABLE DIMENSIONS



# Section 4. Prestart Preparations

---

Before attempting to start the generator set the first time, be certain that it is serviced and ready for operation. Refer to the *Maintenance* section of the Operator's Manual for procedures to add oil, coolant, and fuel.

## LUBRICATION

Engine oil is drained before shipment. Fill the crankcase with the recommended oil before starting.

## COOLANT

Engine coolant is drained before shipment. Fill the cooling system with the recommended coolant before starting.

## FUEL

Fill the fuel tanks with the recommended fuel, and prime the fuel system. All manual shutoff valves should be turned open.

**▲WARNING** *Fuel presents the hazard of fire or explosion which can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette or other ignition source near the fuel system. Keep an ABC type fire extinguisher nearby.*

## VENTILATION

Verify that all air vents and ducts are open and unobstructed. If dampers are used, make sure they operate correctly.

## EXHAUST SYSTEM

Check the exhaust system for proper installation. Make sure that there is at least 12 inches (305 mm) clearance between exhaust pipes and any combustible materials.

## ELECTRICAL SYSTEM

Verify that all electrical connections are secure and that all wiring is complete. Replace and secure any access panels that may have been removed during installation.

### Battery Connections

Use one 12-volt battery for a normal installation. Connect the positive battery cable before connecting the negative battery cable, to prevent arcing.

Service the battery as necessary. If an automatic transfer switch is installed without a built-in charge circuit, connect a separate trickle charger.

**▲WARNING** *Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries produce explosive gas, do not smoke or allow any flame, spark, pilot light, cigarette, arc-producing equipment or other ignition source near the battery area.*

## MECHANICAL CHECK

Check the generator set for loose or damaged components and repair or replace as required.



# Section 5. Operation

## GENERAL

This section describes starting and operating the generator set. Read through this entire section before attempting to start the set. The operator must be completely familiar with the set to operate it safely.

### Prestart Preparations

Before attempting to start the generator set the first time, be sure it is serviced and ready for operation (see Section 4 of this manual). Refer to the Maintenance section of the Operator's Manual for procedures for adding oil, coolant, and fuel.

### Lubrication

Engine oil is drained before shipment. Before starting the genset, fill the crankcase with the recommended oil. Keep the oil level as near as possible to the dipstick high mark without overfilling.

### Coolant

Engine coolant is drained before shipment. Before starting, fill the cooling system with the recommended coolant. Check the coolant level. The coolant should be about two inches below the radiator cap opening. Do not check while the engine is hot.

**⚠ WARNING** *Contact with hot coolant can result in serious burns. Do not bleed hot, pressurized coolant from a closed cooling system.*

## Fuel

Determine the type of fuel system used with the set, then check the fuel supply as follows:

**Gasoline:** Verify that the fuel tanks have sufficient fuel for the expected period of operation.

**⚠ WARNING** *Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, or other ignition source near the fuel system. Keep an ABC type fire extinguisher nearby.*

**Gaseous:** Open all manual shutoff valves in the fuel supply system.

## CONTROL PANEL

All instruments and control switches are on the control panel (Figure 5-1). A DC panel monitors the engine and an AC panel monitors the generator.

### DC Panel

**Oil Pressure Gauge:** Indicates pressure of lubricating oil in engine (wired to a sensor unit located on the engine).

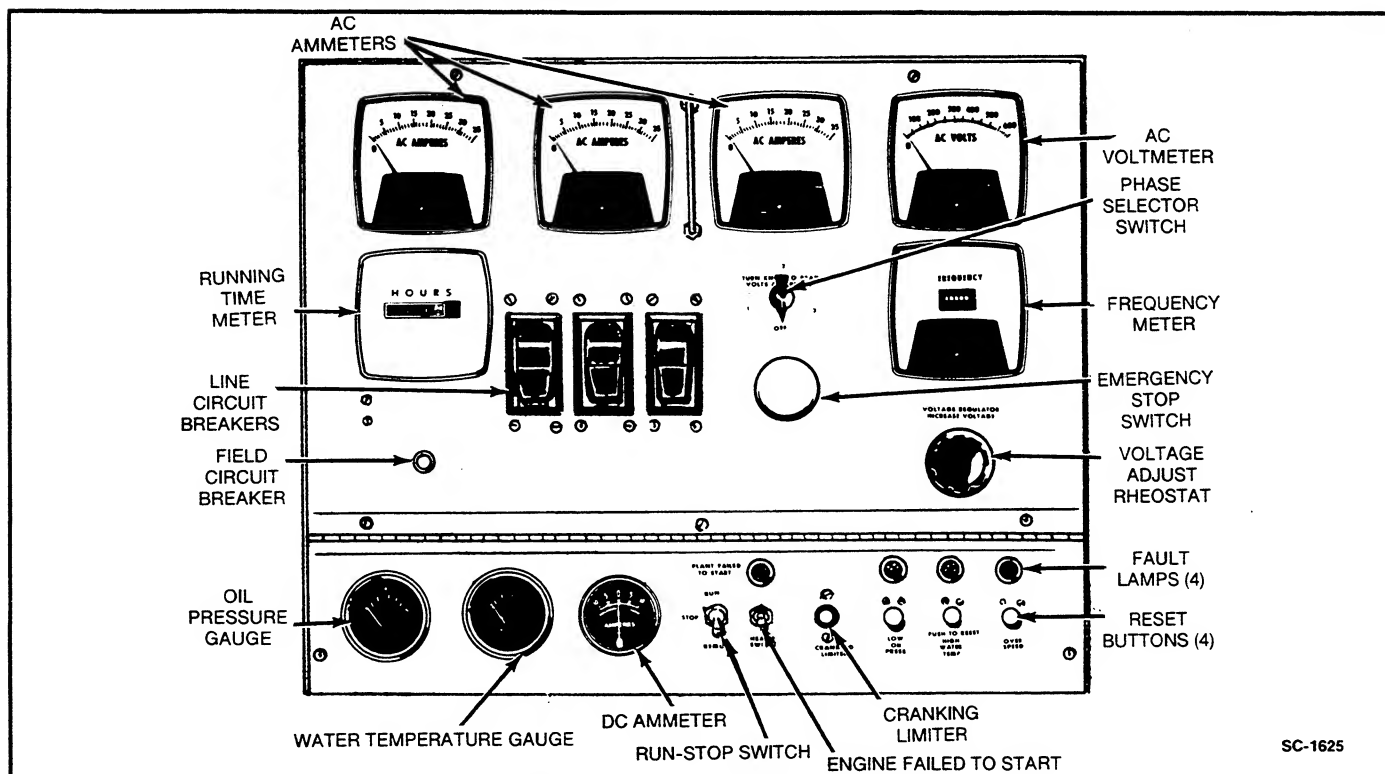


FIGURE 5-1. TYPICAL RADIATOR-COOLED SET CONTROL PANEL

**Water Temperature Gauge:** Indicates temperature of circulating coolant in engine (wired to a sensor unit located on the engine).

**Battery Charge Rate DC Ammeter:** Indicates the battery charging current.

**Run-Stop-Remote Switch:** Starts and stops the unit locally, or from a remote location.

**Red Fault Lamps:** When lighted, these lamps warn of the following conditions:

1. Engine failed to start (optional). Thermally actuated device limits cranking time to between 45 and 90 seconds, depending on ambient temperature. A red pushbutton, the Cranking Limiter, pops out and cannot be reset until one minute has elapsed.
2. Low oil pressure. Indicates engine has shut down due to critically low oil pressure (14 psi/97 kPa or less).
3. High water temperature. Indicates engine has shut down due to critically high temperature of the coolant (215°F/102°C).
4. Overspeed (optional). Indicates engine has shut down due to excessive speed (60 hz unit: 2200 r/min., 50 hz unit: 1900 r/min).

Low Oil Pressure, High Water Temperature and Overspeed functions include automatic shutdown. Reset pushbuttons beneath these lamps allow restarting after the trouble has been corrected.

**AC Voltmeter (optional):** Dual range instrument indicates generator AC voltage. Measurement range shown on indicator light.

**AC Ammeter (optional):** Indicates AC generator line current.

**Frequency Meter (optional):** Indicates generator output frequency in hertz. This may be used to check engine speed (each hertz equals 60 r/min). An analog (pointer) meter is available.

**Voltage Adjust (optional):** Rheostat providing approximately  $\pm 5\%$  adjustment of the rated output voltage.

**Phase Selector Switch (optional):** Selects phases of generator output to be measured by AC voltmeter and ammeter.

**Emergency Stop Switch (optional):** Stops engine when pushed. Must be rotated counterclockwise before engine can be restarted.

**Field Breaker:** Protects generator exciter and regulator from overheating in certain failure modes.

**Running Time Meter:** Registers the total number of hours that the unit has run. Use it to keep a record for periodic servicing. Time is cumulative; meter cannot be reset.

**Line Circuit Breakers (optional):** If a load exceeds the generator current rating, the circuit breaker protecting that line opens. After the problem is corrected, the breaker can be manually reset.

## STARTING PROCEDURE

The following sections cover the three systems used to start the generator set.

### Starting at Control Panel

Move the Run-Stop-Remote switch on the DC panel (Figure 5-1) to the RUN position. This activates the engine control system and the starting system. The starter begins cranking, and after a few seconds the engine starts. The starter disconnects when the engine reaches a speed of roughly 900 r/min.

If the engine does not start, the starter disengages after a specified period of time, and the control indicates an overcrank fault. Generator sets with the standard overcrank control crank continuously as long as 90 seconds before disengaging the starter.

To clear an overcrank fault, place the RUN/STOP/REMOTE switch in the STOP position. Wait one minute, then press the Cranking Limiter (red pushbutton) and repeat the starting procedure.

### Starting From Remote Location

Move the Run-Stop-Remote switch on the generator set DC panel to the REMOTE position. This allows the generator set to be started from a remote switch. Closing the remote switch initiates the starting sequence described in the previous section.

### Automatic Starting

Place the Run-Stop-Remote switch on the generator set DC panel in the REMOTE position if an automatic transfer switch is used. This allows the transfer switch to start the generator set if a power outage occurs and stop it when the power returns.

## STOPPING PROCEDURE

### Before Stopping

Run the generator set at no load for three to five minutes before stopping. This allows the lubricating oil and engine coolant to carry heat away from the combustion chamber and bearings.

## To Stop

If the set was started at the set control panel or at a remote control panel, move the Run/Stop/Remote switch or remote starting switch to the STOP position. If the set was started by an automatic transfer switch, the set will automatically stop about 15 minutes after the normal power source returns. If stop circuit fails, close fuel valve. See Figure 5-2.

## OPERATING RECOMMENDATIONS

Some of the following sections require that a load be connected to the generator set. This is usually done using a load transfer switch. Refer to the transfer switch operator's manual for operation information.

### Break-In

Drain and replace the crankcase oil and reset the valve lash after the first 50 hours of operation on new generator sets. Refer to the *Maintenance* section of this manual for the recommended procedures.

### No-Load Operation

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of heater elements, etc.

### Exercise Period

Generator sets on continuous standby must be able to go from a cold start to being fully operational in a matter of seconds. This can impose a severe burden on engine parts.

To avoid excessive engine wear, exercise the generator set at least once a week for minimum of 30 minutes. Run the set with a load applied to allow the engine to reach normal operating temperature. Exercising will keep the engine parts lubricated, maintain fuel prime, and prevent electrical relay contacts from oxidizing to ensure reliable starts. Top off the fuel tank after each exercise period.

Onan automatic transfer switches have an optional exerciser that can be preset to provide regular exercise periods. Typically, the exerciser can be set for time of start, length of run, and day of week.

### Low Operating Temperatures

Use a tank-type heater if a separate source of power is available. The optional heater available from Onan will provide reliable starting under adverse weather conditions. Be sure the voltage of the separate power source is correct for the heater element rating.

**CAUTION** To avoid damage to the heater, be sure the cooling system is full before applying power to the heater.

## POWER RATING FACTORS

The generator set power rating applies to sets used in standby applications. The set will operate at the stated rating for the duration of normal utility power interruptions. The rating was established for a standard radiator cooled set running on gasoline, natural gas, or propane fuel, operating at an altitude of 300 feet (92 m) with an ambient temperature of 77°F (25°C). For a rating relative to other applications, altitudes, cooling systems, or ambient temperatures, contact an authorized Onan distributor.

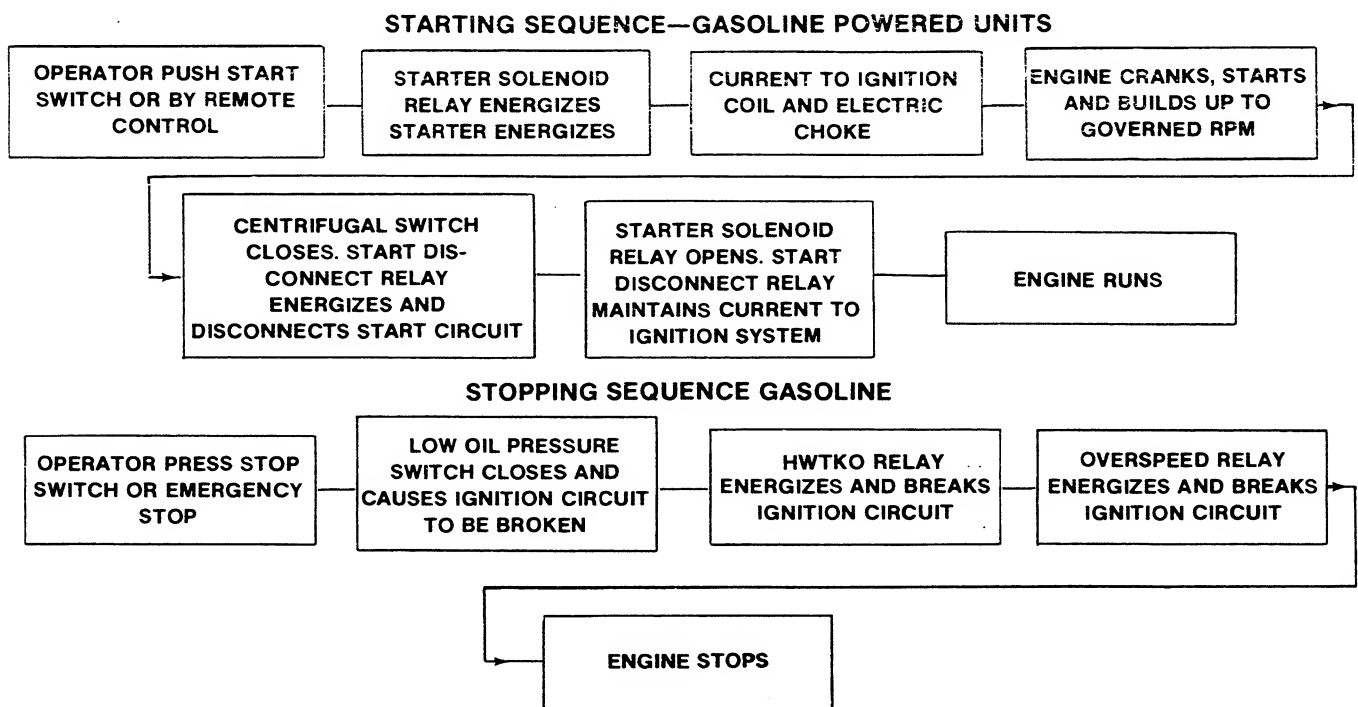


FIGURE 5-2. OPERATING SEQUENCE



# Section 6. Troubleshooting

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The generator set has sensors that continuously monitor the engine for low oil pressure and high coolant temperature. If an abnormal condition occurs, a fault lamp switches on and the engine shuts down. Reset pushbuttons beneath the fault lamps allow restarting after the problem is corrected.

Optional fault lamps with automatic shutdown are available.

Table 6-1 describes the operation of the fault condition system (including optional features) and lists troubleshooting procedures.

## SAFETY CONSIDERATIONS

High voltages are present within the control box and generator output box when the generator is running. Do not open the control box or generator output box while the set is running.

### **⚠ WARNING**

***Contacting high voltage components can cause serious personal injury or death. Keep control and output box covers in place during troubleshooting.***

Generator set installations are normally designed for automatic starting or remote starting. When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted. Place the Run/Stop/Remote switch in the STOP position and remove the negative battery cable from the set starting battery.

### **⚠ WARNING**

***Accidental starting of the generator set during troubleshooting can cause severe personal injury or death. Disable the generator set before troubleshooting.***

When a fault light comes on during operation, follow the procedures in Table 6-1 to locate and correct the problem. If a major problem is indicated, contact an Onan Distributor for service.

**TABLE 6-1. TROUBLESHOOTING**

**⚠ WARNING**

*Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.*

SYMPTOM	CORRECTIVE ACTION
1. HIGH WATER TEMP lamp lights.	<p>1. Indicates engine has overheated (engine temperature has risen above 215°F (101°C), or coolant level is low). Allow engine to cool completely before proceeding with the following checks:</p> <ul style="list-style-type: none"> <li>a. Check coolant level and replenish if low. Look for possible coolant leakage points and repair if necessary.</li> <li>b. Check for obstructions to cooling airflow and correct as necessary.</li> <li>c. Check for slipping fan belt and tighten if loose.</li> <li>d. Reset control and restart after locating and correcting problem. Contact an Onan representative if none of the above.</li> </ul>
2. LOW OIL PRESSURE lamp lights. NOTE: See step 3.	2. Indicates engine oil pressure has dropped to 14 psi (97 kPa). Check oil level and replenish if low. Reset control and restart. Contact an Onan dealer or distributor if oil pressure is not in the range of 30 to 35 psi (207 to 241 kPa).
<p>3. Cranking Limiter pops out and engine stops cranking. ENGINE FAILURE TO START lamp lights</p> <p>or</p> <p>Engine runs, shuts down and LOW OIL PRESSURE Lamp lights.</p>	<p>3. Indicates possible fuel or ignition system problem.</p> <ul style="list-style-type: none"> <li>a. Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required.</li> <li>b. Check for dirty fuel filter and replace if necessary (see <i>Maintenance</i> section).</li> <li>c. Check for dirty or plugged air filter and replace if necessary (see <i>Maintenance</i> section).</li> <li>d. Check for loose connections in the ignition primary, ignition secondary or solenoid valve circuits and correct as required.</li> <li>e. Reset the control and restart after correcting the problem. Contact an Onan distributor for service if none of the above.</li> </ul>



**⚠ WARNING**

*Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.*

SYMPTOM	CORRECTIVE ACTION
4. Engine runs and then shuts down, OVERSPEED lamp lights.	4. Indicates engine has exceeded normal operating speed. Contact an Onan distributor for service.
5. Fault lamp lights but no fault exists. Engine gauges show oil pressure.	5. Reset control. If control will not reset, sensor may be at fault.
6. Engine will not crank.	6. Indicates possible fault with control or starting system. Check for the following conditions: <ul style="list-style-type: none"><li>a. Fault lamp on. Correct fault and reset control.</li><li>b. Poor battery cable connections. Clean the battery terminals and tighten all connections.</li><li>c. Discharged or defective battery. Recharge or replace the battery.</li><li>d. Contact an Onan distributor for assistance if none of the above.</li></ul>
7. No AC output voltage.	7. Field breaker is tripped. Reset breaker. Contact an Onan distributor if voltage buildup causes breaker to trip.



# Section 7. Maintenance

Follow a maintenance and service schedule appropriate to the genset operating conditions. The table below lists service intervals for a standby generator set. If the set is subjected to extreme conditions, reduce service intervals accordingly. Factors that affect the maintenance schedule include:

- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand

Consult with an authorized Onan distributor if the generator set will be subjected to extreme conditions, and determine a suitable maintenance schedule. Use the running time meter as an aid in recording all service performed for warranty support. Service the unit at the time period indicated, or after the number of operating hours indicated, whichever comes first. Use the table to determine the maintenance required, then refer to the following section for service procedures.

**⚠ WARNING** *Accidental starting of the set while performing maintenance procedures can cause serious personal injury or death. Place the Run-Stop-Remote switch in the STOP position and disconnect the negative (-) battery cable from the battery terminal before beginning maintenance procedures.*

**TABLE 7-1. PERIODIC MAINTENANCE SCHEDULE**

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS					
	8	50	100	200	500	1000
Inspect Set	x <sup>1</sup>					
Check Fuel Supply	x					
Check Oil Level	x					
Check Cooling System		x				
Check Air Cleaner		x				
Check Carburetor Preheater (if applicable)			x			
Check Spark Plugs			x			
Check Governor Linkage			x			
Change Crankcase Oil and Filter			x <sup>2</sup>			
Check Battery Water Level				x		
Inspect Breaker Points				x		
Clean Crankcase Breather				x		
Check Zinc Pencils (if equipped)					x	
Clean Carburetor					x <sup>3</sup>	
Remove Carbon & Lead Deposits					x <sup>3</sup>	
Check Valve Clearance					x <sup>3</sup>	
Clean Generator						x <sup>3</sup>
Grind Valves (if required)						x <sup>3</sup>

- <sup>1</sup> - With engine running, visually and audibly check exhaust system for leaks. Shut down set and repair fuel and exhaust leaks immediately. Replace worn, damaged, or corroded exhaust and fuel line components before leaks occur. Refer to the Generator Set Inspection section of this manual for complete inspection procedures.
- <sup>2</sup> - Perform more often under extremely dusty or dirty conditions.
- <sup>3</sup> - Contact Onan Service Center.

## GENERATOR SET INSPECTION

During operation, be alert for mechanical problems that could create hazardous or unsafe conditions. The following sections cover areas that should be monitored to ensure safe operation.

### Engine Gauges

Check the following while the generator set is operating.

**Oil Pressure Gauge:** The oil pressure should be in the range of 30 to 35 psi (207 to 241 kPa) when the engine is at operating temperature.

**Water Temperature Gauge:** The water temperature should be in the range of 150° to 200° F (65° to 93° C) depending on the load and ambient temperature.

**DC Ammeter:** A charging circuit in the generator keeps the engine battery charged, at the rate of approximately 2 amperes.

### AC Meters (Optional)

Check the following while the generator set is operating.

**Frequency Meter:** The generator frequency should be stable. Its reading should be the same as the nameplate rating: 50 or 60 Hertz,  $\pm 5\%$ .

**AC Voltmeter:** Turn the phase selector switch to each line-to-line phase selection shown on the volts scale (L1-L2 on single phase sets; L1-L2, L2-L3, and L3-L1 on three phase sets). With no load, line-to-line voltage(s) should be identical to the set nameplate rating.

**AC Ammeter:** At no load, the current readings should be zero. With load applied, all line currents should be roughly identical, and no line current should exceed the set nameplate rating.

### AC Generator

When inspecting the rotating rectifier assembly, make sure diodes are free of dust, dirt and grease. Excessive foreign matter on the diodes and heat sinks will cause the diodes to overheat, resulting in their failure. Blow out the assembly periodically, with filtered, low-pressure air.

#### **⚠ WARNING**

**Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries produce explosive gas, do not smoke or allow any flame, spark, pilot light, cigarette, arc-producing equipment or other ignition source near the battery area.**

### Batteries

Check the condition of the starting batteries at least every two weeks. See that connections are clean and tight. A light coating of non-conductive grease will retard corrosion at terminals. Keep the electrolyte at the proper level above the plates by adding distilled water. Check specific gravity; recharge if below 1.260.

### Exhaust System

With the generator set operating, inspect the entire exhaust system including the exhaust manifold, muffler, and exhaust pipe. Visually and audibly check for leaks at all connections, welds, gaskets, and joints. Make certain that exhaust pipes are not heating surrounding areas excessively. If leaks are detected, have them corrected immediately.

#### **⚠ WARNING**

**Inhalation of exhaust gases can result in serious personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Stop the generator set and repair any leaks immediately.**

### Fuel System

With the generator set operating, inspect the fuel supply lines, return lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks and abrasions, and make certain they are not rubbing against anything that could damage them.

#### **⚠ WARNING**

**Leaking fuel will create a fire hazard which can result in severe personal injury or death if ignited by a spark. If any leaks are detected, stop the generator set and correct them immediately.**

### DC Electrical System

With the generator set off, check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance, which can hinder starting. Clean and reconnect the battery cables if loose. Always connect the negative (-) battery cable last, to reduce the possibility of arcing.

#### **⚠ WARNING**

**Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries produce explosive gas, do not smoke or allow any flame, spark, pilot light, cigarette, arc-producing equipment or other ignition source near the battery area.**

### Mechanical

With the generator set stopped, check for loose belts and fittings, leaking gaskets and hoses, or any signs of mechanical damage. If any problems are found, have them corrected immediately. With the set running, listen for unusual noises that may indicate mechanical problems.

## LUBRICATION SYSTEM

The engine oil was drained from the crankcase before shipment. Before the initial start, the crankcase must be filled with oil of the recommended classification and viscosity. Refer to Section 2 of this manual for lubricating oil capacity. The following crankcase oils are recommended:

### Gasoline Engines Only

Use oil with the API (American Petroleum Institute) designation SF/CD. Refer to Figure 7-1 for recommended viscosity grades at various ambient temperatures.

### Gaseous-Fueled Engines Only

For best results, use Natural Gas/LPG-Low Ash oil especially formulated for gaseous engine operation, preferably of SF/CD classification. However, if this product is unavailable in the correct viscosity range, a conventional SF/CB or SF/CC lubricant may be used in lower ambient temperatures (approximately 0°F [18°] and colder).

Refer to Figure 7-2 for recommended viscosity grades for different ambient temperatures.

When adding oil between oil changes, use the brand already installed in the engine. Different brands of oil may not be compatible when mixed.

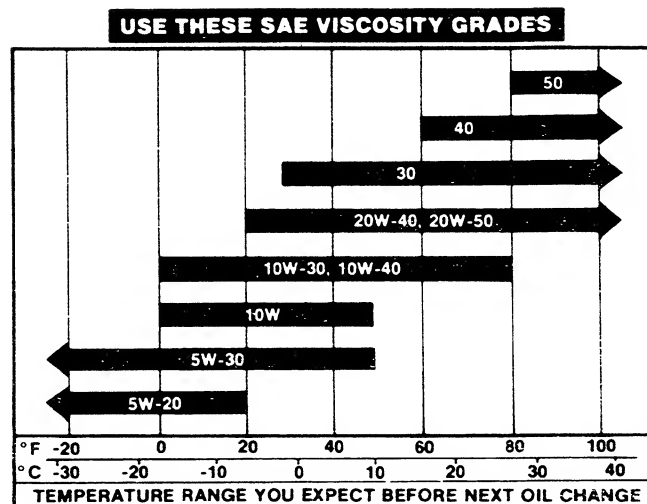
Do not use service DS oil. Do not mix brands or grades. Refer to the table at the beginning of this section for recommended oil change intervals.

### Engine Oil Level

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Table. The oil dipstick and oil fill are located on the side of the engine (see Figure 7-3). The dipstick is stamped with FULL and ADD to indicate the oil level in the crankcase. For an accurate reading, shut off the engine and wait 10 minutes before checking the oil level. This allows oil in the upper portion of the engine to drain back into the crankcase.

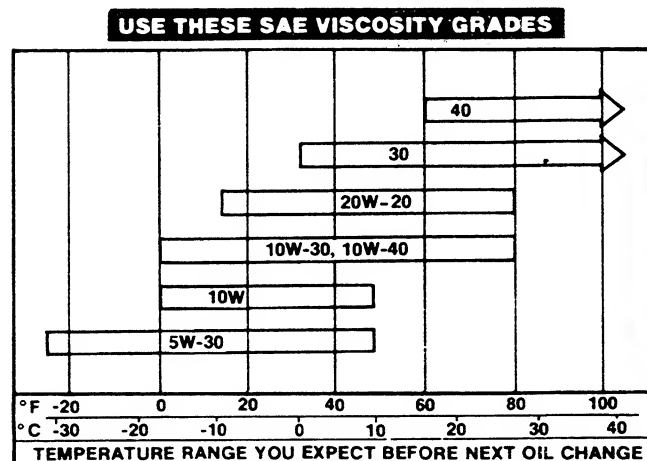
Keep the oil level as near as possible to the FULL mark on the dipstick. Remove the oil fill cap and add oil of the same brand and type when necessary.

**CAUTION** *Do not operate the engine with the oil level below the ADD mark or above the FULL mark. Overfilling might cause foaming or aeration of the oil while operation below the ADD mark can cause loss of oil pressure.*



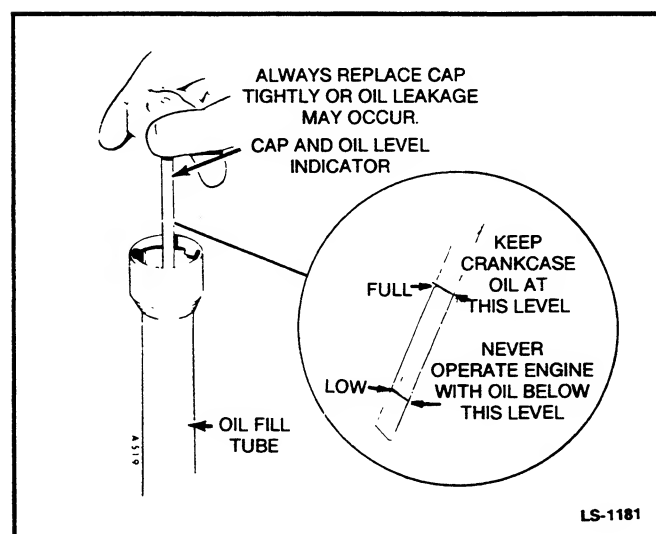
LS-1184

FIGURE 7-1. SAE VISCOSITY GRADES, GASOLINE ENGINES



LS-1185

FIGURE 7-2. SAE VISCOSITY GRADES, GASEOUS FUEL ENGINES



LS-1181

FIGURE 7-3. OIL LEVEL INDICATOR

**Engine Oil Change:** Run the engine until thoroughly warm before draining oil. Stop the engine, place a pan under the drain outlet and remove the oil drain plug or open the drain valve. After the oil is completely drained, replace the drain plug or close the drain valve. Refill with oil of the correct API classification and the appropriate SAE viscosity grade for the temperature conditions.

**⚠ WARNING** *Hot crankcase oil can cause burns if it is spilled or splashed on skin. Keep fingers and hands clear when removing the oil drain plug and wear protective clothing.*

**Oil Filter Change:** Spin off the oil filter and discard it. Thoroughly clean the filter mounting surface. Apply a thin film of oil to the filter gasket and install the new element. Spin the element on by hand until the gasket just touches the mounting pad, then turn an additional 3/4 to 1 turn. Do not overtighten.

With oil in the crankcase, start the engine and check for leaks around the filter element. Retighten only as much as necessary to eliminate leaks, but do not overtighten.

### PCV Valve

After every 500 hours of operation, clean the PCV valve. To do this, remove both rocker covers. Remove the retaining ring from the top of the PCV valve. Remove the internal element of the PCV valve and clean in a petroleum-base solvent. Dry and reinstall. See Figure 7-4.

**⚠ WARNING** *Petroleum-based solvents can be extremely flammable and can cause severe personal injury or death if ignited. Keep fire, flame, sparks, cigarettes, pilot lights and other sources of ignition away while performing this procedure.*

### Crankcase Breather Cap

Remove the breather cap from the breather tube. At the same time, pull the baffle out of the breather tube and clean it. See Figure 7-5.

## COOLING SYSTEM

The cooling system on each set is drained before shipping, and must be refilled before the generator set can be operated. Cooling system capacity of the standard unit with a set-mounted radiator is listed in Section 2 of this manual.

### Coolant Requirements

Engine coolant inhibits corrosion and protects against freezing. In warm climates, use a mixture of rust inhibitor and water as the coolant. In cold climates, use a 50/50 mixture of water and antifreeze. If temperatures below -37°F (-38°C) are possible, use a mixture of 65% anti-freeze and 35% water.

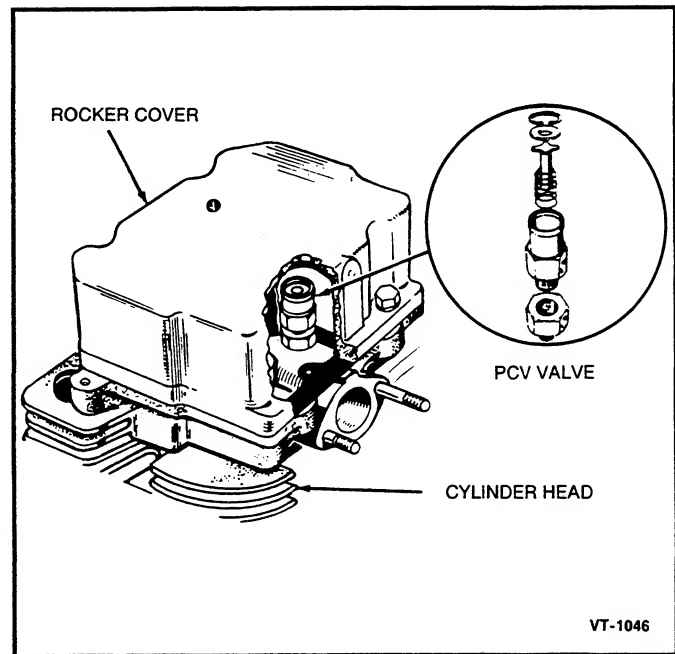


FIGURE 7-4. PCV VALVE

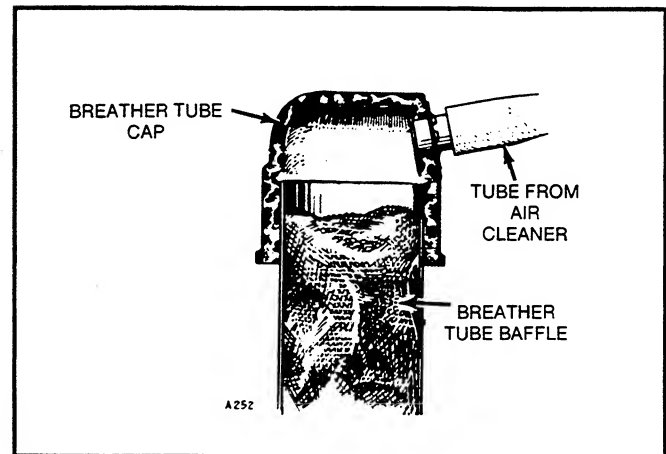


FIGURE 7-5. BREATHER CAP

The water used for engine coolant should be clean, low in mineral content, and free of corrosive chemicals such as chloride, sulphate, or acid. Use soft water when available; well water often contains lime and other minerals which may eventually clog the radiator core and reduce cooling efficiency.

### Filling the Cooling System

Verify that all drain cocks are closed and all hose clamps secure. Remove the cooling system pressure cap and slowly fill the cooling system with the recommended coolant.

**⚠CAUTION** *Do not pour hot water into a cold engine or cold water into a hot engine. Doing so might crack the head or the cylinder block. Do not operate the unit without water for even a few minutes.*

When the engine is first started, remove the pressure cap and monitor the coolant level. As trapped air is expelled from the system, the coolant level will drop, and more coolant should be added. Replace the pressure cap when the coolant level is stable.

### Coolant Level

Check the coolant level during the genset shutdown periods at the intervals specified in the maintenance table at the beginning of this section. Remove the radiator cap after allowing the engine to cool. If necessary, add coolant until the level is near the top of the radiator.

**⚠WARNING** *The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury from the hot coolant. Remove the radiator pressure cap slowly after the engine has cooled.*

**⚠CAUTION** *High Engine Temperature Cutoff will shut down engine in an overheat condition only if coolant level is high enough to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. Maintain adequate engine coolant levels for operational integrity of the cooling system and engine coolant overheat shutdown protection.*

### Draining and Flushing

The standard RJC unit is radiator-cooled. The cooling system, including the block and radiator, should be cleaned and flushed at least once a year. This is especially important in cold weather, or when preparing the unit for extended storage (over 30 days).

The thermostat is calibrated to start opening at 150°F. Test the thermostat.

If the unit includes a water-cooled exhaust manifold to be used with a heat exchanger, it should be drained and flushed at least once a year.

For identification purposes, left and right sides of the set are defined while viewing the set from the engine (radiator) end.

The following drain plugs must be removed to allow complete flushing of the cooling system.

**Radiator:** One petcock, lower right rear corner.

**Engine Block:** One drain plug, left front near water pump.

**Heat Exchanger:** One drain plug, bottom right rear corner of heat exchanger.

**Expansion Tank:** One drain plug, lower right rear corner.

**Water Pumps:** One drain plug, under cover or by loosening cover.

If a water jacket tank heater (optional) is used, it should be drained and flushed. The lower hose must be disconnected at the tank heater. There is no drain plug.

Further information concerning the location and part numbers of the various drain plugs throughout the unit is contained in the parts catalog.

### Testing Thermostat

If a sticking or faulty thermostat is suspected, test as follows:

1. Remove the thermostat from the cylinder head.
2. Heat a pan of water to approximately 150°F, checking the temperature using a thermometer.
3. Suspend the thermostat in 150°F water. It should start to open.
4. After the thermostat has opened completely, remove it from the hot water and allow it to cool. The thermostat should close within a short time.
5. If the thermostat sticks or does not operate properly, replace it.
6. Install a new gasket with the replacement thermostat.

## FUEL SYSTEM

Use clean, fresh, regular grade automotive gasoline. With new engines, best results are obtained with unleaded gasoline.

**⚠WARNING** *Ignition of fuel can cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, spark, pilot light, or other igniter near the fuel system.*

## Carbon and Lead Deposits

**⚠ WARNING** *Inhalation of chemical sprays can cause severe personal injury or death. Use safety goggles to protect eyes and a respirator or painter's mask to prevent inhaling any chemical that may spit back from the carburetor during this procedure. Also, work in a well-ventilated area to avoid subjecting other personnel to any fumes.*

**⚠ WARNING** *Fumes from this cleaner present the hazard of fire or explosion, which can cause severe personal injury or death. Do not allow any spark, flame, pilot light, lit cigarette, or other ignition source near the generator set when performing this procedure. Keep a fire extinguisher rated ABC near the work area.*

Perform the following tasks as indicated on the maintenance schedule, to keep the carburetor and intake manifold clean, and to keep carbon deposits from forming in the combustion chamber. Use Onan 4C cleaner. If engine pinging or power loss occur, consult an Onan distributor.

This procedure also removes lead deposits from engines that have previously used leaded gasoline.

1. Start the generator set and allow it to warm up to normal operating temperature.
2. Stop the generator set.
3. Remove the air cleaner housing and air filter.
4. Restart the generator set, and spray the 4C cleaner into the carburetor, directing the spray to wash the choke plate and inside walls. Spray as much as possible into the carburetor without stalling the engine. The spray enters the combustion chamber and softens the carbon, allowing it to flake off and exit through the exhaust pipe. When an ounce of the chemical remains in the can, flood the engine until it stops.
5. Leave the engine off for 15 minutes while the product continues to soften the carbon.
6. Restart the engine without load on the generator. Gradually add load. When the generator set is under full load, let it run for a few minutes to blow out the carbon.

### Air Cleaner

After every 50 hours of operation remove and clean filter element, Figure 7-6.

**⚠ CAUTION** *Do not clean the filter element by immersing it in a cleaning solution, or the element might be damaged.*

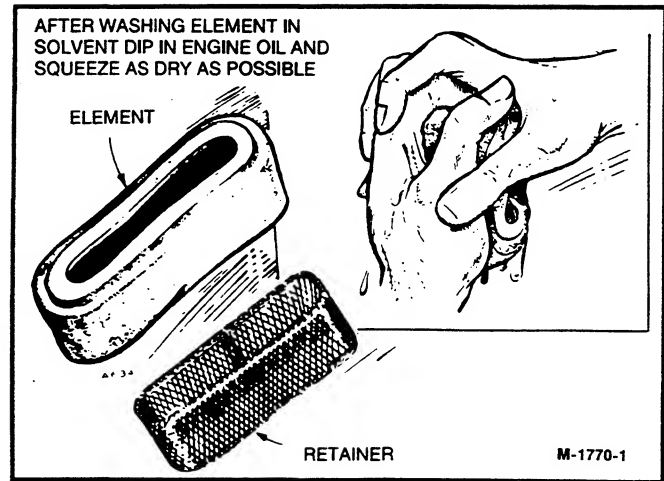


FIGURE 7-6. POLYURETHANE FOAM AIR CLEANER



### Optional Oil Bath Air Cleaner

1. Loosen the bottom clamp, remove the cleaner base and clean (see Figure 7-7).
2. Refill the base to oil level mark with the same weight oil used in the engine.

### Carburetor Air Preheater

During subfreezing temperatures, humidity can freeze and accumulate in the carburetor, causing the engine to stall.

The preheater prevents this accumulation by diverting the discharged warm air to the air cleaner. A thermostatically controlled shutter in the induction air stream selects the air source. The shutter is fully closed at 80°F (26°C), half open at 90°F (32°C) and fully open to ambient air at 100°F (37°C).

To check the shutter, loosen the hose as shown in Figure 7-8 and inspect the mechanism.

### Filter Sediment Bowl

After every 100 hours of operation, remove the sediment bowl from the fuel filter body, Figure 7-9. Clean out contaminants from the sediment bowl. When reinstalling the sediment bowl, make sure that the gasket and screen are in place.

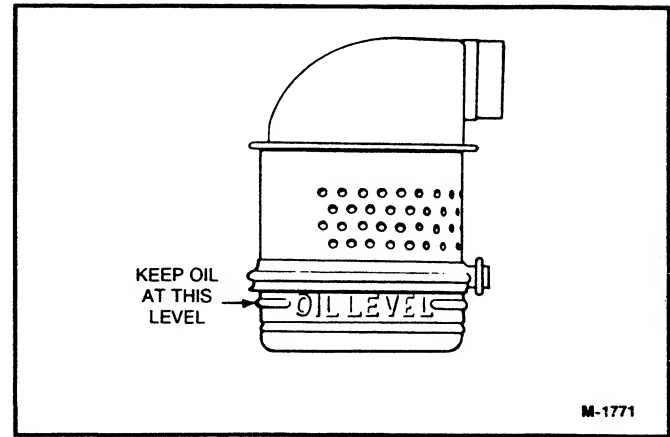


FIGURE 7-7. OIL BATH AIR CLEANER

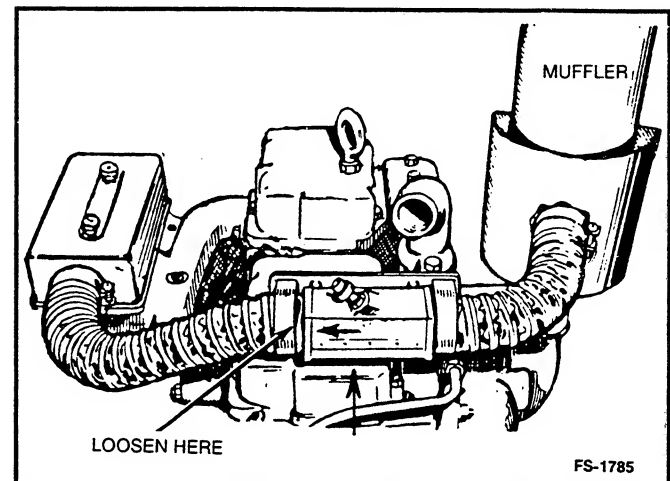


FIGURE 7-8. CARBURETOR AIR PREHEATER

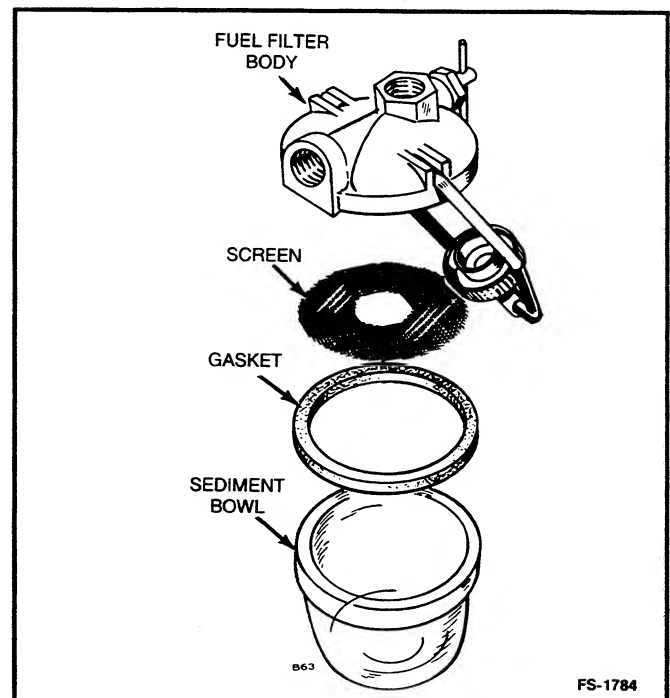


FIGURE 7-9. FUEL FILTER

## Governor Linkage

Clean ball joints (Figure 7-10) periodically for smooth governor operation.

## IGNITION SYSTEM

The ignition system includes the ignition coil, distributor with spark advance and breaker points, spark plugs, high voltage wires and battery. The ignition system must be completely functional, or the set may run poorly or be unable to carry full load. Perform the following inspections at the recommended intervals.

### Distributor Cap

Remove the distributor cap and inspect the inside for cracks, burn marks, deterioration of the carbon center button, or eroded terminals. Replace the cap if any of these conditions are visible. Light scaling on the rotor tip can be removed with a knife blade.

### ⚠CAUTION

*The rotor can be damaged if dropped or handled roughly. Use care to avoid bending the rotor blades while inspecting the rotor.*

Remove the rotor and scrape the inside surface of the rotor ground strap. This will enable the shutter blades to be well grounded to the distributor shaft.

### Spark Plugs

Remove the spark plugs and inspect for cracked or damaged insulators, worn electrodes, damaged gaskets, or excessive carbon deposits. Replace any spark plugs with these conditions. Clean those plugs that can be reused, and regap them (see Figure 7-11) as specified in Section 2 of this manual. Clean all dirt and grit away from the spark plug seats before installing the plugs. Tighten to 20 ft-lbs (27 n•m) torque.

If the plugs show any of the following conditions, the engine may require additional service. Contact an Onan distributor for assistance.

**Black carbon fouled:** over-rich fuel mixture

**Oil fouled:** high oil consumption

**Burned or overheated:** excessive combustion chamber temperature

### High Voltage Wires

Check the spark plug wires and coil wire for good contact at the coil, distributor cap and spark plugs. Terminal connections should be tight and fully seated. All spark plug covers and cable end boots should be in good condition and fit tightly. There should be no breaks or cracks in the insulation. Replace the wire if any of these conditions are noted.

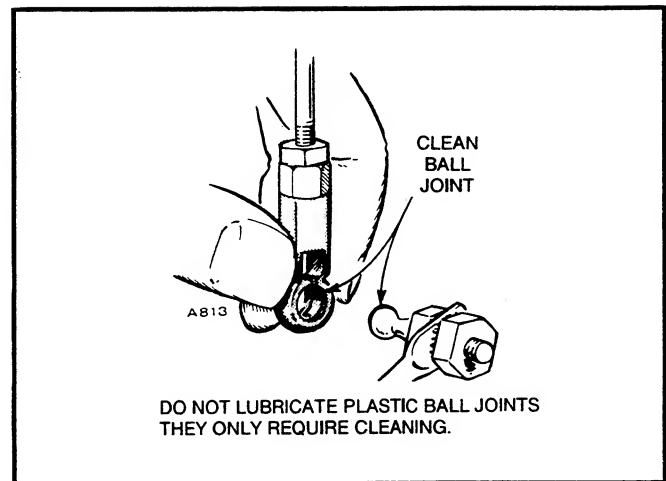


FIGURE 7-10. GOVERNOR LINKAGE

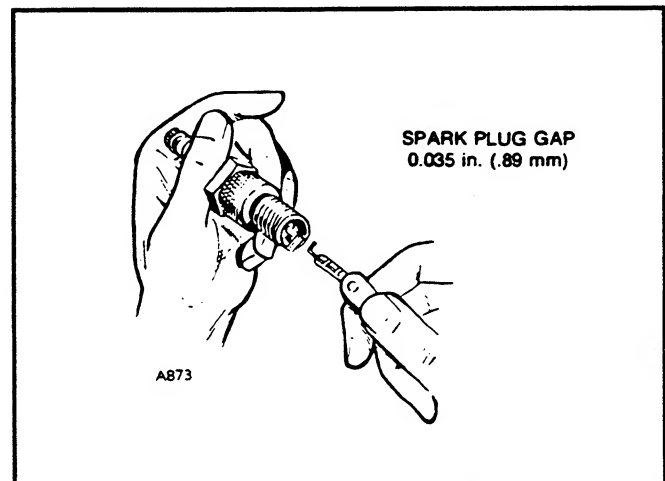


FIGURE 7-11. GAPPING SPARK PLUGS

**⚠CAUTION** *High voltage wires can be damaged if removed incorrectly from terminals. Grasp each wire by its spark plug cover or boot to prevent damage to conductor.*

### Ignition Coil

Clean the top of the ignition coil and check for cracks, carbon tracks, or corrosion in the high tension terminal hole. Replace the coil if any of these conditions are noted.

### Battery

Check the condition of the starting battery at the interval specified in the *Periodic Maintenance Schedule* at the beginning of this section. Always disconnect the negative (-) connection from the battery before working on any part of the electrical system or the engine. Disregard the manual sections on *Checking Specific Gravity* and *Checking Electrolyte Level* if using a maintenance-free battery.

**⚠WARNING** *Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries produce explosive gas, do not smoke or allow any flame, spark, pilot light, cigarette, arc-producing equipment or other ignition source near the battery area.*

**Cleaning Battery:** Keep the battery clean by wiping with a damp cloth whenever dirt appears excessive.

If corrosion is present around the terminal connections, remove battery cables and wash the terminals with an ammonia solution or a solution consisting of 1/4 pound of baking soda added to 1 quart of water (100 g/litre).

Be sure the vent plugs are tight to prevent cleaning solution from entering the cells. After cleaning, flush the outside of the battery and surrounding areas with clean water.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or non-conductive grease to retard corrosion.

**Checking Specific Gravity:** Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. Hold the hydrometer vertical and take the reading. Correct the reading by adding four gravity points (0.004) for every five degrees the electrolyte temperature is above 80°F (27°C), or by subtracting four gravity points for every five degrees below 80°F (27°C). A fully charged battery will have a corrected specific gravity of 1.260. Charge the battery if the reading is below 1.215.

**Checking Electrolyte Level:** Check the level of the electrolyte (acid and water solution) in the batteries at least every 200 hours of operation.

Fill the battery cells to the bottom of the filler neck. If cells are low on water, add distilled water and recharge. If one cell is low, check case for leaks. Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

**⚠CAUTION** *Do not add water in freezing weather unless the engine will run long enough (two to three hours) to assure a thorough mixing of water and electrolyte. Incomplete mixing may allow the electrolyte to freeze and cause battery damage.*

### DRIVE BELTS

Inspect each belt for cracks, fraying or glazing. Replace any belt with these conditions.

Check belt tension by applying a force of 15 lbs. to the midpoint of each belt. If the belt tension is correct, the belt should deflect about 0.50 in. (12 mm). Adjust belt tension as required for the recommended tension.

### AC GENERATOR

Because there are no brushes, brush springs or collector rings on these generators, they require very little servicing. Periodic inspections, to coincide with engine oil changes, will promote good performance.

Periodically remove the generator cover and blow out dust and debris with filtered low-pressure air.

**⚠CAUTION** *Excessive foreign matter on diodes and heat sinks will cause overheating and possible failure.*

### OUT-OF-SERVICE PROTECTION

When the set is to be stored or removed from operation for an extended period of time, take the following precautions to prevent rust accumulation, corrosion of bearing and mating surfaces within the engine, and gum formation in the fuel system.

#### Preparing Set for Storage

To protect a set that will be out of service for more than 30 days, proceed as follows:

1. Run the set until thoroughly warm, with the generator under at least 50 percent load.
2. Shut down the engine and drain the oil base while still warm. Refill and attach a warning tag indicating the oil type and weight used.
3. Remove the spark plugs. Pour 1 ounce of rust inhibitor (or SAE #10 oil) into each cylinder. Crank the engine over several times. Reinstall the spark plugs.
4. Service the air cleaner.

5. Clean the throttle and governor linkage, and protect them by wrapping with a clean cloth.
6. Plug the exhaust outlets to prevent entrance of moisture, insects, dirt, etc.
7. Clean and wipe the entire unit. Coat parts susceptible to rust with a light coat of grease or oil.
8. Check the coolant level; add recommended coolant if necessary.
9. Disconnect the battery, negative (-) cable first, and follow the standard battery storage procedure.
10. Provide a suitable cover for the entire unit after it has cooled down.

### **Returning a Unit to Service**

1. Remove the cover and all protective wrapping. Remove the plug from the exhaust outlet.
2. Check the warning tag on oil base and verify that the oil type is still correct for the ambient temperature.
3. Clean and check the battery. Measure specific gravity (1.260 at 77°F [25°C]) and verify the level to be at the split ring. If the specific gravity is low, charge until the correct value is obtained. If the level is low, add distilled water and charge until the specific gravity is correct. **DO NOT OVERCHARGE.**

### **⚠ WARNING**

***Ignition of explosive battery gases might cause severe personal injury. Do not smoke while servicing batteries.***

4. Check that the fuel filter and fuel lines are secure, with no leaks.
5. Check the carburetor and adjust if necessary.
6. Connect the battery, positive (+) cable first.
7. (Liquid cooled sets) Check the coolant level, and add coolant if necessary.
8. Verify that no loads are connected to generator.
9. Start the engine.

After the engine starts, excessive blue smoke will be exhausted until the rust inhibitor oil has burned away.

10. After start, apply an electrical load to at least 50 percent of rated capacity.
11. Make certain all gauges read correctly. The unit is ready for service.

## FILLING HEAT EXCHANGER

Improper filling of the heat exchanger (Figure 7-12) can cause overheating of the engine. To prevent this possibility, follow these instructions when adding coolant to the heat exchanger.

**⚠ WARNING** *The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury from the hot coolant. Remove the pressure cap slowly after the engine has cooled.*

1. Remove fill cap.
2. Open fill vent valve (turn counterclockwise).
3. Remove vent plug.
4. Fill with coolant until vents begin to overflow.
5. Close fill vent valve (turn clockwise).
6. Replace vent plug.
7. Replace fill cap.
8. Operate unit 10 minutes at full load, watch for leaks.
9. Shut down unit.
10. Slowly open pressure cap and check water level.
11. Fill system to top with coolant.

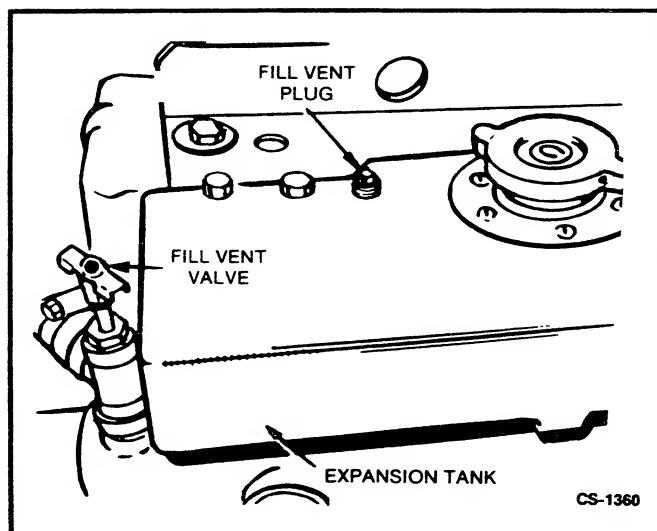


FIGURE 7-12. FILLING HEAT EXCHANGER



# Section 8. Adjustments

## START-DISCONNECT SWITCH

The start-disconnect centrifugal switch (Figure 8-1) is on the side of the engine above the oil filter. It opens when the engine stops and closes when engine speed reaches roughly 900 rpm. If necessary, turn the stationary contact and adjust the point gap to 0.020 inch (.51 mm). Replace burned or faulty points.

**⚠ WARNING** *Accidental starting of the set while performing maintenance procedures can cause serious personal injury or death. Place the Run-Stop-Remote switch in the STOP position and disconnect the negative (-) battery cable from the battery terminal before beginning maintenance procedures.*

## CARBURETOR (GASOLINE)

The carburetor (Figure 8-2) has a main fuel (high speed) adjustment and an idle fuel adjustment. Early models have the main adjustment needle on the top of the carburetor. The main adjustment affects operation under heavy load conditions. Idle adjustment affects operation at light or no load. Under normal circumstances, factory carburetor adjustments should not be disturbed. If the adjustments have been disturbed, turn the needles off their seats 1 to 1-1/2 turns to permit starting, then readjust them for smooth operation.

**⚠ CAUTION** *Do not force the idle screw against the seat. Damage to the screw and seat will result otherwise.*

Before final adjustment, allow the engine to warm up. To set the main fuel adjustment, apply a full electrical load to the generator, and carefully turn the main adjustment screw in until the engine speed (or output frequency) drops slightly below normal. Turn the screw back out (richer) approximately 1/4 turn or until the engine speed (frequency) returns to normal.

Carburetor adjustment should be made after the governor is properly adjusted.

Make the idle adjustment with no load connected to the generator. Use a tachometer, or connect a frequency meter to the generator output. Slowly turn the idle adjustment slightly below normal. Then turn the needle in until the engine speed (generator frequency) returns to normal.

Set the throttle stop screw (located on the carburetor throttle lever) with no load connected, and while running at the rated speed. Turn the stop screw to provide 1/32 inch clearance between the screw and pin (Figure 8-2).

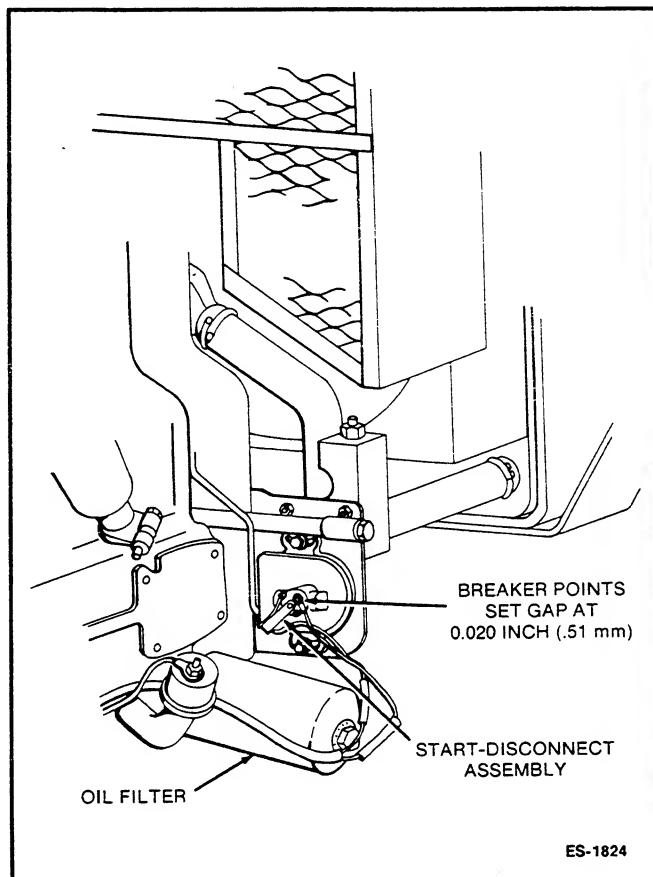


FIGURE 8-1. BREAKER POINTS

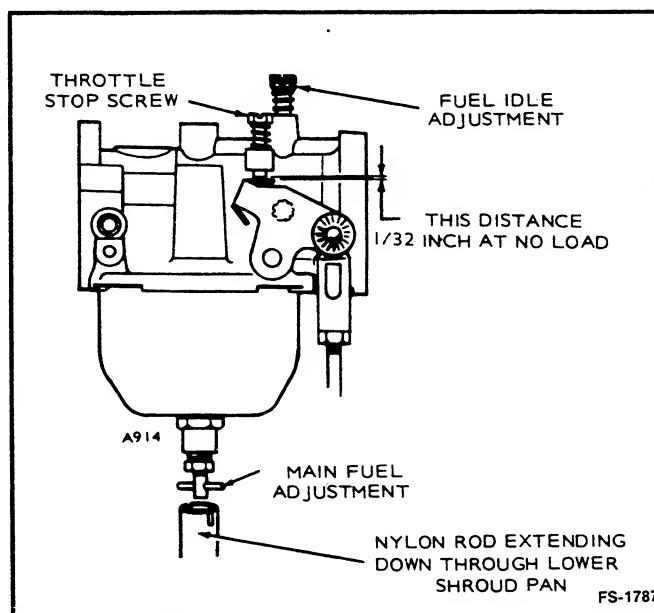


FIGURE 8-2. CARBURETOR ADJUSTMENTS

## CARBURETOR (GASEOUS)

The gaseous carburetor adjustment procedure is the same as the gasoline procedure. See Figure 8-3 for location of the adjusting needles.

## ONAN THERMO-MAGNETIC CHOKE

This choke uses a heating element with a heat-sensitive bimetal spring to open the choke. The choke solenoid, actuated only during engine cranking, closes the choke depending on ambient temperature. During gaseous fuel operation, the choke is locked in the full open position by the choke lock wire.

The choke bimetal spring must be at ambient temperature for adjustment. Allow the engine to cool at least one hour before adjusting the choke.

To adjust the choke, turn the choke body, which engages a link connected to the choke spring. Remove the air cleaner and adapter to expose the carburetor throat. Loosen the screw which secures the choke body. Rotate the choke body clockwise to increase the choking action (richer) and counterclockwise to decrease the choking action (leaner). Refer to Figure 8-4 for the correct choke setting for each ambient temperature. Use a drill rod or the shank of a drill bit to measure the choke opening.

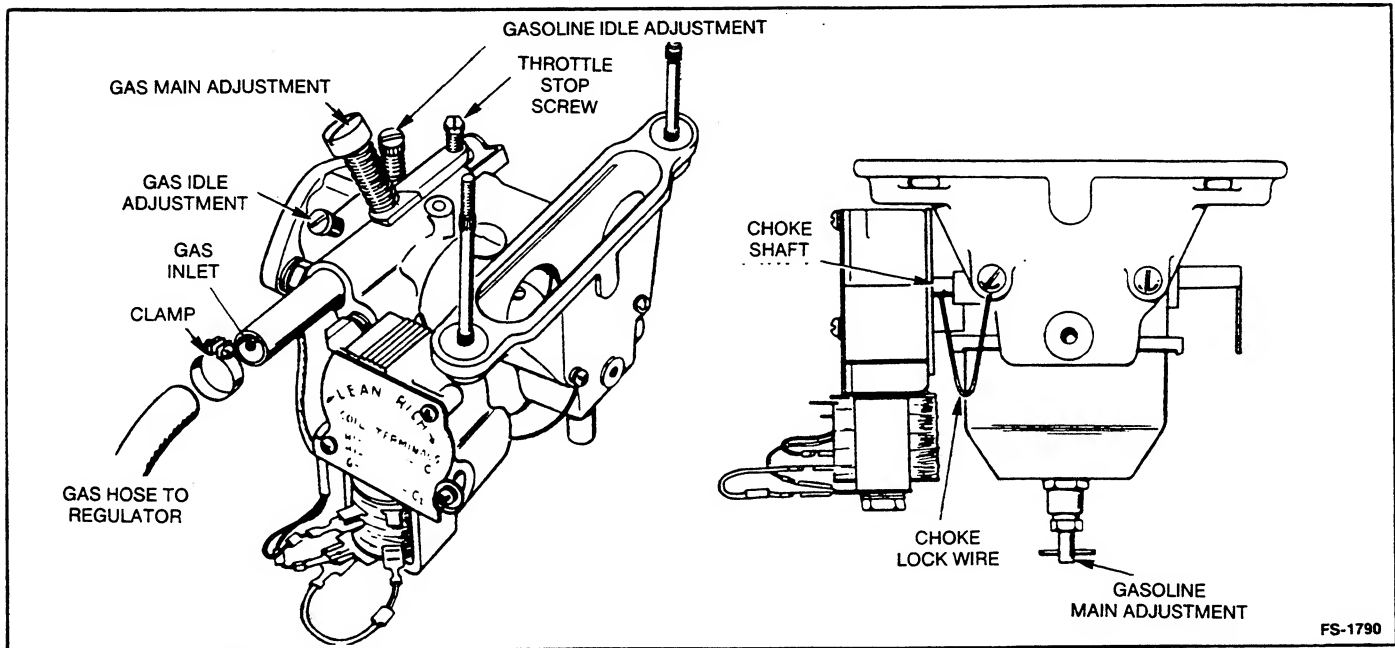


FIGURE 8-3. GAS-GASOLINE CARBURETOR ADJUSTMENT

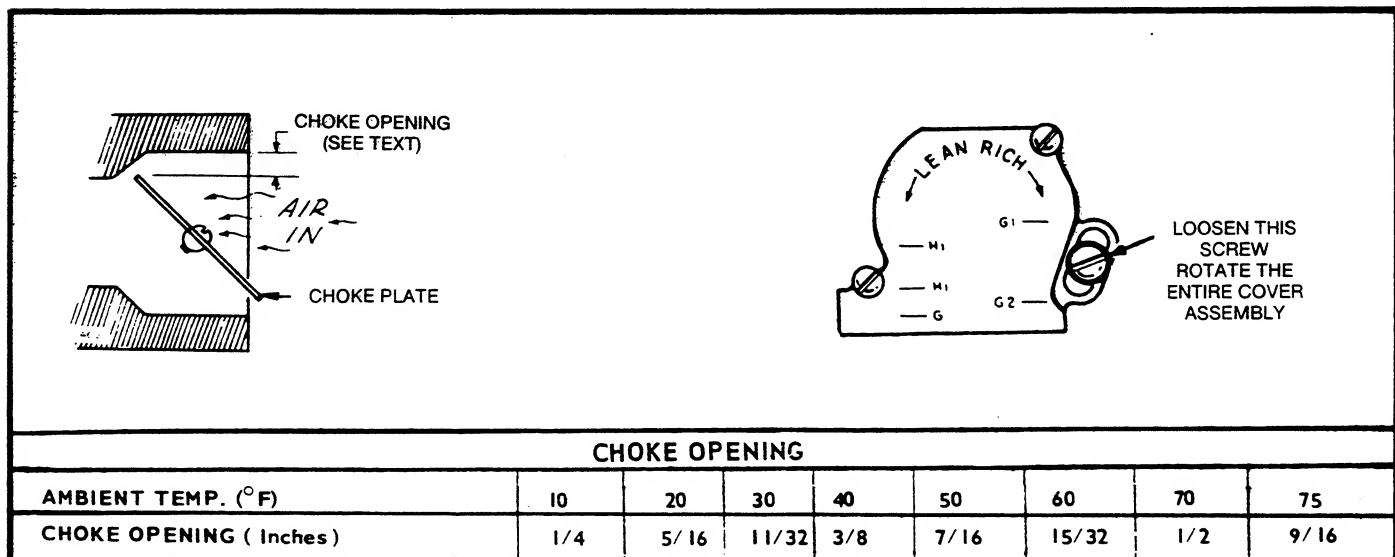


FIGURE 8-4. THERMO-MAGNETIC CHOKE SETTING

FS-1788



## GOVERNOR

The governor controls engine speed. Rated speed and voltage appear on the nameplate (see Section 2 of this manual). On a 4-pole generator, engine speed equals frequency multiplied by 30. Thus 1800 rpm gives 60 hertz frequency. Preferred speed does not vary more than 3 hertz from no-load to full-load operation. Be sure throttle, linkage, and governor mechanism operate smoothly.

### Speed Adjustment

To change the governor speed, change the spring tension by turning the governor spring nut (Figure 8-5). Turn the nut clockwise (more spring tension) to increase RPM and counterclockwise to reduce governed speed.

### Sensitivity Adjustment

To adjust governor sensitivity (no load to full load speed droop) turn the sensitivity adjusting ratchet. Counterclockwise gives more sensitivity (less speed drop when full load is applied), clockwise gives less sensitivity (more speed drop). If the governor is too sensitive, a rapid hunting condition occurs (alternate increasing and decreasing speed). Adjust for maximum sensitivity without hunting. After sensitivity adjustment, the speed will require readjustment. After adjusting the governor, secure speed stud lock nut.

Excessive droop may be caused by engine misfiring. Correct this condition before adjusting governor.

## CHARGE RATE ADJUSTMENT

The adjustable resistor slide tap (in the charging circuit) is located in the generator air outlet. It is set for a 2 ampere charging rate. In frequent-start applications, check battery specific gravity periodically, and if necessary, slightly increase the charging rate (move slide tap nearer ungrounded lead) until the battery stays charged. Adjust the slide tap only when the engine is stopped. Avoid overcharging the battery.

If a separate automatic demand control for starting and stopping is used, adjust the charge rate for its maximum 4.5 amperes. This normally keeps the battery charged even if starts are made at 15 minute intervals.

## FAN BELT

To adjust the fan belt, loosen the nut on the belt tightener pulley shaft. Move the shaft left or right in the elongated slot in the pulley mounting bracket until a belt deflection of 1/2 inch (12.7 mm) is obtained when roughly 15 pounds (20 n•m) of force is applied at a point midway between the fan pulley and the belt tightener pulley. Be sure to tighten the nut securely.



**WARNING** Contact with moving parts on a running generator set can cause severe personal injury or death. Make certain that the generator set is stopped, and the starting battery disconnected, negative (-) cable first, before attempting any fan belt adjustments.

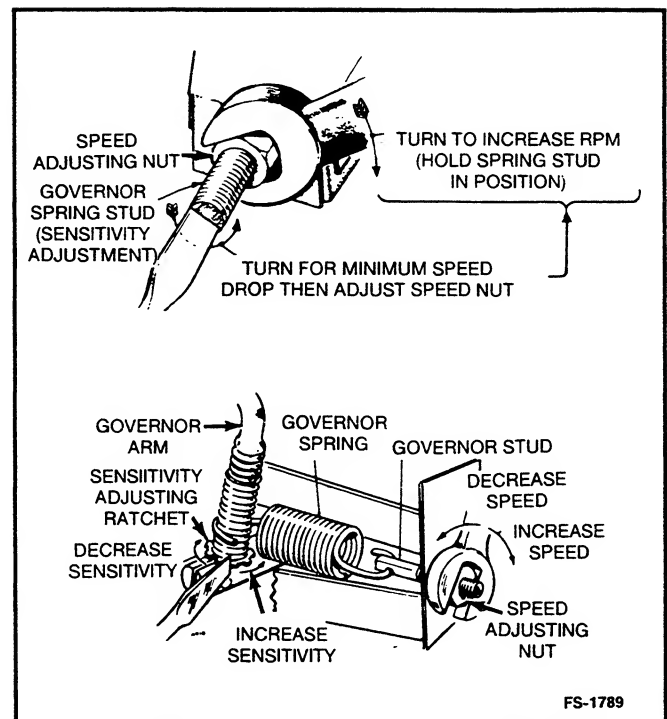


FIGURE 8-5. GOVERNOR ADJUSTMENT

## BREAKER POINTS ADJUSTMENT

To adjust the breaker points, remove the distributor cap and rotor. Rotate the crankshaft to get maximum breaker gap. The gap should be .020 inch (.51 mm) or 48 to 50 degrees of dwell. At the same time, inspect the points for dirt or pitting. Dirty or pitted points must be replaced. See Figure 8-6.

Check the distributor cap for cracks, carbon runners, corroded high tension terminals or excessively burned rotor contacts.

## TIMING - SINGLE POINT IGNITION

The single points ignition system may be timed with the engine either stopped or running. Before timing the ignition, be sure the breaker points are clean and properly adjusted. Refer to Section 2 of this manual for the correct timing setting.

### Engine Stopped

1. Disconnect the low voltage lead to the distributor and connect a test lamp and battery so the lamp lights when the breaker points are closed.
2. Remove the spark plug from #1 cylinder and rotate the flywheel clockwise until air is forced out of the spark plug hole.
3. Observe the timing pointer and continue rotating the flywheel slowly until the test lamp goes out, indicating that the breaker points have opened. If the TC mark on the flywheel and the ignition timing pointer on the gear cover are aligned, the timing is correct.
4. To adjust the timing, align the flywheel TC mark and the timing pointer. Loosen the distributor body and rotate it (clockwise if ignition occurred early and counterclockwise if it occurred late) until the light goes out. Tighten the distributor body in the new position and check the timing, step 3. If timing still does not occur at the correct point, repeat step 4.

### Engine Running

1. Install an automotive timing light on the spark plug for cylinder #1. Run the engine at rated speed. Aim the flashing timing light toward the flywheel mark and pointer on the gear cover.
2. The timing pointer on the gear cover must align with the timing mark. To adjust the timing, loosen the distributor body clamp and rotate the distributor body. If the timing is early (mark to the right of the point), rotate the distributor clockwise to retard the ignition point. If the timing is late (mark to the left of the point), rotate the distributor counterclockwise to advance the ignition point.

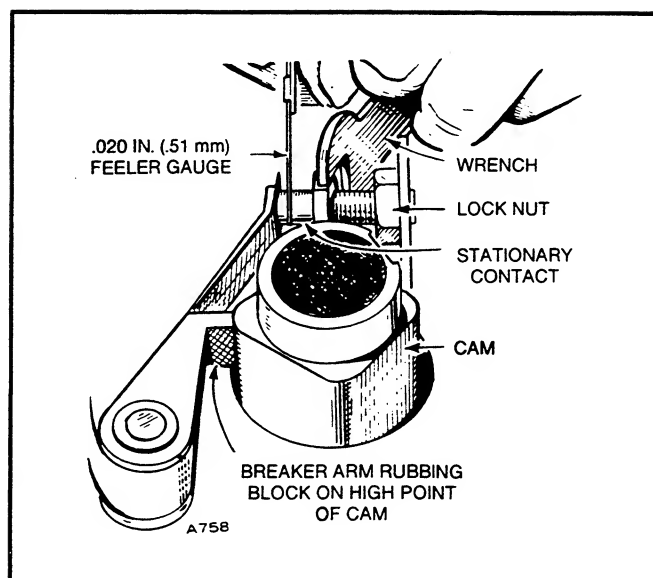


FIGURE 8-6. SETTING SINGLE BREAKER POINTS





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